

COMPETITIVENESS OF THE AEROSPACE INDUSTRY

Y 4. C 73/7: S. HRG. 103-223

Competitiveness of the Aerospace In...

HEARING

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

MAY 19, 1993

Printed for the use of the Committee on Commerce, Science, and Transportation



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COMPETITIVENESS OF THE AEROSPACE INDUSTRY AND S. 419

WEDNESDAY, MAY 19, 1993

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The committee met, pursuant to notice, at 10 a.m. in room SR-253, Russell Senate Office Building, Hon. Byron L. Dorgan, presiding.

Staff members assigned to this hearing: Patrick H. Windham, professional staff member, and Samuel E. Whitehorn, senior counsel; and Alan Maness, minority senior staff counsel.

OPENING STATEMENT OF SENATOR DORGAN

Senator DORGAN. We will call the hearing to order this morning. Chairman Hollings may be with us shortly. He is returning to the Hill from an engagement downtown.

Today's hearing is a hearing on the competitiveness of the aerospace industry, and also a hearing on S. 419 introduced by our colleague, Senator Danforth.

The challenges facing the aerospace industry these days are many. The manufacturers in this country have laid off thousands of workers. Boeing announced a 28,000-person layoff earlier this year. McDonnell-Douglas has cut back to 19,000 employees from 40,000 to 43,000 just a few years ago. All of us understand that our aerospace manufacturing industry has faced enormous and stiff competition from Airbus. Many of us feel that that competition is not fair competition, but nonetheless it has taken away much needed business from American manufacturers.

The airline industry that those manufacturers serve has lost \$10 billion over the last 3 years. PanAm, Eastern, and Midway are simply memories, carriers that serve no longer. The industry has cut back aircraft orders during this difficult time by some \$41 billion, and that has caused rather significant production changes by manufacturers. It has also caused changes by not just airframe manufacturers but engine manufacturers and others.

President Clinton has indicated a commitment to looking at the problems of the airlines and the manufacturers. He met with the CEO's of the airlines of this country at a hanger at Boeing a couple of months ago. The National Commission to Ensure a Strong Competitive Airline Industry conceived by this committee and our colleague, I believe principally Senator Exon and others, is underway as well.

The manufacturing industry is a global market. U.S. producers rely in many respects on foreign manufacturers for parts and supplies, and we also provide some parts and supplies to other manufacturers of aircraft overseas.

We do not know quite what to expect in this industry, but all of us understand that we face significant challenges and, we hope, significant opportunities.

As I mentioned our colleague, Senator Danforth, has introduced legislation that would focus on one aspect of responding to some of these challenges. And we are pleased to conduct this hearing today and hear from witnesses who I think will give us some interesting and different perspectives about the competitiveness of the aerospace industry—where we are and what we must do to retain a healthy aerospace manufacturing industry in the future. Mr. Chairman, your comments, please.

OPENING STATEMENT OF SENATOR HOLLINGS

The CHAIRMAN. Today the committee is holding a hearing on the U.S. aerospace industry, which, like many other U.S. industries, has suffered severe economic decline in recent years. For the last 3 years, this country has experienced a significant recession. Thousands of people lost their jobs, while the past administration waited for the free market to turn around. The U.S. airline industry and the aircraft manufacturing industry have been no stranger to this downturn.

The U.S. air carriers have lost more than \$10 billion over the last 3 years, and PanAm, Eastern, and Midway have ceased operations. The industry has been forced to lay off people and reduce significantly capital spending. In the aerospace industry, we have seen thousands of layoffs at Boeing, McDonnell Douglas, and engine manufacturers like Pratt & Whitney.

Today's hearing gives us the opportunity to examine more carefully what has happened to the aircraft manufacturing sector. Clearly one problem for the U.S. aircraft manufacturing industry is the declining health of the air carriers. A \$50 million plane cannot be sold if the buyer cannot afford it or already has excess capacity. The carriers already have canceled or deferred about \$41 billion in aircraft orders. Clearly we must begin to address the financial problems in the airline industry.

Furthermore, the aircraft manufacturing industry faces stiff foreign competition. The U.S. aircraft manufacturing industry clearly operates in a global market, and competition from Airbus is a significant factor in its survival. We know that Airbus has received subsidies—the Europeans wanted to create an industry, and it has cost them \$26 billion, according to one study. Airbus would not be here today but for the subsidies. However, for 11 years, the past administrations did little to address the problem. Finally, in July 1992, the Bush administration negotiated an agreement, signed by all parties, which limits subsidies by the Europeans. The question is whether this agreement is enough.

The current administration is concerned about the state of the airline and aerospace industries. Earlier this year, President Clinton flew to Seattle and met with airline CEO's in Boeing's hangar. The Airline Commission, conceived by this committee and pushed

by the President, next week will begin its review of these industries and their problems. In addition, the President has proposed to increase aeronautics research by more than \$350 million through the National Aeronautics and Space Administration and the Federal Aviation Administration. We need to explore how such programs can assist the U.S. aerospace industry.

I look forward to hearing from our witnesses today on these issues, and on S. 419, legislation proposed by Senator Danforth that is intended to address concerns about the aerospace industry.

Thank you, Mr. Chairman.

Senator DORGAN. Thank you, Mr. Chairman. Let me now call on my colleague, Senator Danforth, for an opening statement.

OPENING STATEMENT OF SENATOR DANFORTH

Senator DANFORTH. Mr. Chairman, thank you very much. Thank you for chairing this hearing.

There is a Presidential commission that has been established, and it will complete its work hopefully some time in August. I am concerned that the pace at which we are proceeding on is too leisurely to deal with what has become a very critical problem. The aerospace industry in the United States should be the premier industry in our country. It has been in the past. It is obviously critically important to the future of our country.

I think that the question could fairly be asked, If we do not succeed in the aerospace industry what is it that we plan to succeed in?

This is not a low-technology industry. This is not an industry that can be done equally well anywhere. It should be something that is right at the heart of America's economic future. And yet as you pointed out, Mr. Chairman, the aerospace industry has been undergoing very severe problems. Since 1989, there has been a 25-percent reduction in jobs in the aerospace industry.

Part of this is because of unfair competition from Airbus. It is unfair competition. Airbus has never made money in its history. For a couple of decades, it has been very heavily subsidized. It has been subsidized to the tune of \$26 billion. A company that has been so heavily subsidized should not be operating now. And yet Airbus has 28 percent of the worldwide market, and it has 44 percent of our market in the United States.

Another problem of the aerospace industry is the plight of our airlines. That is another subject that has been frequently before this committee. The airlines are basket cases for a number of reasons. The airlines are the leading customer of the aerospace industry, and as the airlines go so goes aerospace.

And then a third component is that what the aerospace industry does, at least substantial parts of it, is related to what the Federal Government does. A good part of aerospace is involved in national defense. It is involved in NASA. And that is a very dangerous business to be in, doing business with the Federal Government. Not only are budgets totally unpredictable, rapidly changing, always matters of debate, but if you do business with the Federal Government, if you are in the defense industry, you can expect to be hauled before various committees of Congress and berated for whatever it is you are doing.

So, this is a very troubled industry, and it should not be a troubled industry. Several of us introduced a couple of bills a few months ago. One is to require a countervailing duty case brought by our Government against Airbus. To me, that is something that should be done. That legislation is really in the nature of an editorial comment because the Commerce Department has the power to institute a countervailing duty case. The President also has the power to veto a bill. So, ultimately the decision is in the executive branch, not in Congress.

But it was a point that I wanted to make, and some other Members of Congress wanted to make. The Airbus situation should not be permitted to continue, and we should avail ourselves of the power that we have under international agreement to institute countervailing duty cases.

And then the second piece of legislation which you pointed out, Mr. Chairman, is the aerotech bill. It has a number of cosponsors, both Democrats and Republicans. And the idea of that legislation is to provide for private sector input into the spending of about \$10 billion, which the Federal Government now does each year, in the research and development area in aerospace, and also to use as a model for aerospace what SEMATECH was for the semiconductor industry to make it possible for a consortium of U.S. aerospace industries, with the support of the Government, to join together in the development of new technologies for that industry.

I am glad we are having this hearing. I really do believe that time is of the essence. I am concerned that the commission, while it is always nice to have commissions, will turn out to be yet another study. I think the time for action has come.

Senator DORGAN. Thank you very much. Senator McCain.

OPENING STATEMENT OF SENATOR MCCAIN

Senator MCCAIN. Thank you, Mr. Chairman. I want to thank you and Chairman Hollings for holding this hearing. It is obviously a critical issue for America. And, understandably, most of our attention will be focused on the aerospace industry and the airlines. I would like to talk about another aspect of the issue in just a minute.

But I also am glad to see Dr. Perry here, because it has been little noticed but it has been a very important factor in aerospace and general aviation that the Department of Defense has played a key role in financing many of the technologies that have contributed directly to the predominance of our civilian aviation sector.

Areas that I think we should be looking at are predatory pricing restrictions, elimination of proposed aviation fuel tax increases under the energy tax initiative, Federal loan guarantees for the purchase of new stage 3 aircraft, provisions for airlines to expend immediately their accumulated net operating losses to obtain a refund of earlier ticket tax payments, foreign investment in U.S. airlines, and the relationship between such investments and the rights of U.S. and foreign carriers under international aviation treaties. And, of course, the problems of compliance with new environmental standards and efforts to preserve the environment have affected the industry considerably.

I just want to point out one very important issue, I think, to the future of aerospace industry and aviation, and the airline industry, and that is the deplorable, outrageous situation we find ourselves in in the area of general aviation. Production of new general aviation aircraft has plummeted from 18,000 just a few years ago to 1,021 last year. Industry employment has been cut in half.

Cessna Aircraft, which used to produce nearly 9,000 aircraft a year, has not produced a single- or twin-engine piston-powered airplane since 1986. Piper Aircraft is in bankruptcy largely due to product liability costs.

And the dire straits of this previously healthy industry has serious consequences, in my view, from the area of training of pilots, to competition with foreign manufacturers, to frankly the preservation of an industry that was almost exclusively the United States.

Mr. Chairman, unless we have some kind of product liability reform in the general aviation industry, we will not see the general aviation industry in this country exist. It is not difficult. It is something that everyone agrees needs to be looked at.

The average age of a piston aircraft, a single-engine aircraft today in America is 27 years. And unfortunately, and I do not like to single out any particular target, but unfortunately the American Trial Lawyers Association has failed to even sit down and discuss this issue with the Congress and with the general aviation industry to try and bring about some kind of agreement to save an industry.

So, I would hope that part of our examination today, and some of our witnesses might talk about the fact that we are depriving a generation of young Americans of the ability to learn to fly. And, frankly, we are depriving tens of thousands of Americans of the ability to work because of the demise of the general aviation industry in America.

I thank you, Mr. Chairman.

[The prepared statement of Senator McCain follows:]

PREPARED STATEMENT OF SENATOR MCCAIN

Thank you, Mr. Chairman. I'd like to thank the witnesses for appearing before this Committee today and I look forward to their testimony.

A strong commercial aircraft industry is critical to the health of the United States economy. Senator Danforth's bill, S. 419, calls for the creation of a new Government-industry relationship to address the current problems of the U.S. aerospace industry both here and abroad. It is imperative at this time that the Congress show strong leadership in this matter. We owe it to our competitive spirit which built the industrial base of this nation and we owe it to those highly skilled workers who build the high technology planes that have made the United States the leader in the aerospace industry.

As companies on the leading edge of technology development, aerospace firms have much to offer as America strives to retain its competitive strength in a wide range of industries. I know it is clear to everyone on this committee and this panel that aerospace advancements have helped spur innovations and productivity in many other business sectors. The aerospace industry consistently contributes to the U.S. trade balance and provides hundreds of thousands of jobs for American workers. The aerospace industry is the nation's leading manufacturer exporter. In 1991, the aviation industry sold \$68.6 billion worth of aircraft, aircraft engines and parts. Exports of \$45 billion in 1992 produced a trade surplus of \$31.4 billion. Sales in 1992 reflected a dramatic decline from 1991's sales. The recent decline in aviation industry sales is the result of defense spending cutbacks and sluggish economic performance.

The industry's backlog has also decreased to \$214 billion in 1992 from \$235 billion in 1991. Due primarily to the financial problems of the airline industry, orders for commercial aircraft fell off by more than 25 percent in 1991. These effects are felt

most harshly in the pocketbooks of those families who depend on the aviation industry for jobs. Aerospace manufacturers were forced to cut 130,000 jobs in 1992, a decline of 11 percent. Estimated job losses of 10 percent in 1993 will drop total industry employment to 942,000. This would be the first time in 15 years that aerospace jobs would fall below one million.

In the past, the aerospace industry might have turned to the military sector to see it through a slump in airline orders. However, with the end of the Cold War, the Defense budget is being cut dramatically. For the U.S. aerospace industry, the military is no longer a guaranteed market, nor is it a reliable source for R&D funding. The decline in the market is plainly evident. Foreign and domestic deliveries of new military aircraft in 1991 is down 14 percent from 1990 totals. When military procurement was growing, much of the risk of developing new technology, from prototype through operational aircraft, was covered by Government contracts. In many cases, technology developed for the military would be incorporated into commercial aircraft, including Boeing's 707 and 747 aircraft, Douglas' DC-9 and DC-10, and Lockheed's L-1011. I believe that the traditional link for stimulating commercial aviation development is in danger of breaking in the post Cold War era unless we can emphasize and focus the aerospace industry through these difficult times ahead.

Let me make it perfectly clear that I am not suggesting that Government subsidize the aviation industry. Each company or industry bears ultimate responsibility for market success or failure. U.S. manufacturers should be challenged to invest in new applied technology, new equipment and processes, and in their employees; improve productivity; provide the best quality; and produce competitively priced products. However, the government should foster an environment in which the industry can prosper.

Contrast this to the continual government support for Airbus Industrie Groupe. Over the last 25 years, the European governments of France, Germany, Spain, and the United Kingdom have provided massive subsidies to their national company partners in the Airbus Consortium to aid the development, production and marketing of large civil aircraft. Although the exact figure of how much funding Airbus has received directly from European Community support is unknown—one estimate places that figure at \$26 billion between 1971 and 1989. As of December 1992, Airbus has captured an estimated 33 percent of the worldwide commercial aircraft industry and 44 percent of the U.S. market. Airbus has replaced McDonnell Douglas as the second largest aircraft manufacturer in the world.

Nearly three weeks ago, the White House released the list of 15 voting members and 11 non-voting members of the National Commission to Ensure a Strong Competitive Airline Industry. The Commission was established with the express purpose of addressing these issues. However, having had the pleasure to serve as the ranking Republican on the Aviation Subcommittee for years and had the opportunity to study, discuss and hear testimony from many well qualified experts and representatives in the aviation industry, I am very concerned by the lack of airline and aerospace industry representatives on the Commission.

Moreover, I firmly believe that we cannot afford to wait for the Airline Commission to release its report before we begin to consider these important issues. In this regard, myself and several other members on the Aviation Subcommittee wrote to Chairman Ford on April 26, 1993 regarding a list of legislative initiatives that this committee should explore in view of the airline industry's well-documented financial crises. Rather than waiting for the Commission's recommendations, we should immediately consider and hold hearings on:

- Predatory pricing restrictions
- Elimination of proposed aviation fuel tax increases under the energy tax initiative
- Federal loan guarantees for the purchase of new Stage 3 aircraft
- Provisions for airlines to expend immediately their accumulated net operating losses to obtain a refund of earlier ticket tax payments
- Foreign investment in U.S. airlines and the relationship between such investments and the rights of U.S. and foreign carriers under international aviation treaties
- Compliance with new environmental standards and efforts to preserve the environment have affected the industry considerably

All these issues are important but I am particularly concerned about the impact of product liability laws on the aerospace industry, especially the general aviation industry. As I travel throughout Arizona I hear many pleas from general aviation pilots who have seen the demise of a once thriving industry in the United States. In an industry heavily dominated by the concerns of airlines, the needs of the general aviation industry must not be ignored. There are several critical issues affecting the financial health of general aviation, including proposals to increase registration

fees and energy taxes that could cripple this aviation sector. Product liability has been the single greatest obstacle to the success and survival of the American light aircraft industry.

Production of new general aviation aircraft has plummeted from 18,000 just a few years ago to 656 last year. Industry employment has been cut in half. Cessna Aircraft, which used to produce nearly 9,000 aircraft a year, has not produced a single or twin-engine piston powered airplane since 1986. Piper Aircraft is in bankruptcy, largely due to product liability costs.

The dire straits of this previously healthy industry has serious consequences. If we do not provide new training aircraft for our future pilots, what will happen to our air transportation system? The average age of the single-engine aircraft is now 27 years. Increased foreign competition is targeting the U.S. marketplace with a great number of general aviation airplanes.

The general aviation industry is intensely regulated by the federal government. Every stage of design, production and testing is scrutinized by the Federal Aviation Administration. The general aviation industry is in dire need of a uniform federal standard of liability to dovetail with the existing system of federal regulation. In a meeting last week, the President of Cessna told me that the company would resume production of piston powered aircraft if the legislation introduced this year by Senator Kassebaum, of which I am a cosponsor, was approved by the Congress.

I truly believe that the future of the aviation industry and the aerospace industry depends on the strong leadership that this body can provide—I hope we are all up for the challenge.

Thank you very much, Mr. Chairman and I look forward to hearing from all of our witnesses.

Senator DORGAN. Thank you very much. The first two witnesses today will be our colleagues, Senator Dodd and Senator Lieberman. First we will hear from you, Senator Dodd. Thank you for being with us.

STATEMENT OF HON. CHRISTOPHER J. DODD, U.S. SENATOR FROM CONNECTICUT

Senator DODD. Well, thank you very much, Mr. Chairman. I have a prepared statement and ask unanimous consent that it be included in the record.

Let me just before beginning, second the comments of our colleague from Arizona, Senator McCain. And certainly Senator Danforth in the committee has more than just a passing interest in that same issue, as does my colleague from Connecticut, Senator Lieberman. And we are hopeful that in a broad-based way we are going to be able to deal with product liability legislation this year.

You mentioned the aerospace industry or the general aviation industry as one example. As I know the Senator from Arizona knows, this issue cuts across manufacturing from one end of the country to the other. So, it clearly needs to be addressed, and I think the support is there for it, certainly in the Senate.

At any rate, Mr. Chairman, I am delighted to appear before you this morning, along with my colleague from Connecticut, to offer some thoughts and some observations on the state of the American aerospace industry. I particularly want to thank you, Mr. Chairman, for holding these hearings. I think it is critically important that we focus attention on this issue.

And I want to recognize Senator Danforth for his initiative in introducing the Aeronautical Technology Consortium Act of 1993 of which many of us are cosponsors and which, as I am sure you have heard from him already, would place under a single roof nearly \$10 billion in Federal aerospace R&D funds that are now spread across a multitude of programs and agencies, and not very effectively, in our opinion, doing the job.

A central feature of the legislation would enable aerospace firms to work together in a consortium to develop joint approaches to a variety of technological challenges that lie ahead of us. This formula is modeled after the SEMATECH consortium, an ongoing Federal program that has helped restore the competitiveness, I think all would agree, of the semiconductor industry in a very short matter of time. It is a wonderful example of what we are utilizing here, what Senator Danforth has put together, and the sooner we act on that the better I think we will all be.

In the hours ahead, Mr. Chairman and members of the committee, I am sure you are going to hear a great deal about the global competitiveness of U.S. aerospace industries, the importance of aerospace to our national and defense industrial base, and the continued need to keep America on the cutting edge of new technologies. And I certainly do not disagree or have any argument with those discussions at all. Those are central to the issue that you will be taking up today and they deserve a good deal of consideration.

But I would like in the brief amount of time here this morning that you have given me, Mr. Chairman, to concentrate on a somewhat different aspect of this problem. Not too long ago, I had the opportunity to visit an engine component facility maintained by the Pratt & Whitney Division of the United Technologies Corp. in Southington, CT. And I know my colleague as well has been there recently. This particular facility provides more than 1,300 jobs and is a critical part of the economy in that region of the State. Unfortunately, over the course of the next few years the entire facility may be completely and permanently shut down.

When I visited this division I had the opportunity not just to hear from the people who manage the books and make the high-level decisions in the corporate board rooms, but we also met with the men and women who punch the clock every day and put in their hours on the shop floor. And I spoke with them about the circumstances they face today and the challenges that they expect to confront tomorrow. And what I heard was an outpouring of concern for their jobs, their families, their futures, and our country's future.

Too often we think that these people only talk about their immediate economic security, and I wish the entire Senate could have gone through and listened to the comments. The first concerns raised by many of these people was the loss of this facility. There is machinery in that shop that does not exist in any other place in this country in terms of testing engines in this Nation. In fact, foreign countries come here to test their equipment at this facility, this one division in Southington, CT.

You lose that, these people were saying, it is not just their jobs they worry about. Obviously, they are concerned about that. But they are also concerned about our ability to replace that kind of technology base. And obviously the corporation has to grapple with complicated financial decisions.

But nonetheless it was interesting to note—we oftentimes think people on the shop floor only care about their benefits, only care about their wages. These people cared about what is happening to this industry and the country. They are people who worked, in talking to them, celebrating their 25th, 26th, 30th year working in

these facilities. Knowledgeable, talented people who hate to see this kind of technology going by the boards.

As I said, many of these people have given the better part of their working lives to this U.S. industry. They have contributed to the national security of our Nation, they have developed job skills and capabilities that would make them the envy of any modern corporation, and they soon may face the prospect of filing unemployment and seeing that facility be shut down.

Mr. Chairman, in Connecticut and across the country these difficulties are magnified many times over. In 1989, there were roughly 1,330,000 people working in the aerospace industry. By the end of 1993, only 4 years later, that number has dropped down to about 990,000. In Connecticut, we have lost 13,000 aviation-related jobs in the past 4 years alone at major corporations such as United Technologies and Hamilton Standard, and the fear among many is that these high-paying, high-skilled, high-value jobs may be gone forever.

Mr. Chairman, on a number of occasions I have talked to the working men and women of these facilities in Connecticut and many other facilities in our State. These individuals have shared their thoughts on how we should collectively address some of these challenges, and let me just briefly identify a few that seem to surface quite frequently in their discussions.

First, any action we take must be done quickly, and I think the establishment of the Airline Commission on a very short leash is a very wise step for us to move in that direction. The challenges in the industry in this country take on a number of different forms, ranging from the decline in defense spending to the growth of overseas competition to the continuing struggle in the commercial airline sector. We should keep in mind that all of these problems are related, and we cannot address one to the exclusion of the others.

Second, we should keep in mind the advantages as well as the disadvantages of competing in this increasingly global economy. We must take quick and lasting action to address the unfair trade distortion subsidies of the European Community and others. Senator Danforth, the second piece of legislation that you have introduced goes to the heart of that particular question and while the Senator from Missouri is not an isolationist, nor do I think any of us are here, we are getting our clock cleaned in this area.

I do not know how else you get the attention of people that we are serious about this subject-matter, and it is not just a question of capital investments and the talent of the workforce and taxes and a lot of other things that are legitimate issues. There are clear unfair practices that our country is suffering from as a result of what is occurring in the European Community and, one may argue, in the Pacific Rim nations as well.

Third, we must not allow our focus on the health of the industry to distract us from the pressing concerns that are faced every day by working men and women. Initiatives to increase the industry's access to technology are important and should be undertaken. But we must also keep in mind that the best resource we have in this country is a skilled and well-trained workforce.

As someone said the other day, the best part of a jet engine is the person who builds it, and if we lose that talent, that human

talent that takes years to acquire, then we are jeopardizing the future of this industry, and we are simply not going to be competitive in this area if we do not have the kind of skill levels that our workforce needs.

In conclusion, Mr. Chairman, I want to thank you for holding these hearings this morning to focus attention on this issue. It means a great deal to us in our State in a parochial way, but I want to emphasize what I am sure my colleague will stress as well.

Our constituents are concerned about their jobs and their families and their homes, but I heard over and over again their deep concern about this industry and the future of it in this country. And your initiative in holding these hearings, focusing attention on this issue, is of the utmost importance. I believe the administration is certainly as interested as we are. The fact that they have supported the Airline Commission, that they intend to get some good ideas and then act up here on some of these ideas, possibly can save an industry and jobs and a critical technology for our Nation's future.

I will end by just underscoring a note that the Senator from Arizona ended his comments on, in regard to product liability reform, and I believe that that is a critical element, I would add, in this debate and discussion and how we deal with those problems.

So, I thank you for allowing us to come by and share some thoughts with you this morning.

[The prepared statement of Senator Dodd follows:]

PREPARED STATEMENT OF SENATOR DODD

Mr. Chairman and distinguished members of the committee, I appreciate this opportunity to appear before you this morning to offer some thoughts and observations on the state of the American aerospace industry. I particularly want to thank the distinguished chairman of this committee, Senator Hollings, for holding this very important hearing and for inviting me to testify before the committee on this very important subject.

I also want to take this opportunity to recognize the distinguished ranking minority member of this committee, Senator Danforth, for his initiative in introducing the Aeronautical Technology Consortium Act of 1993. This legislation, of which I am an original cosponsor, would place under a single roof the nearly \$10 billion in Federal aerospace R&D funds that are now spread out across a multitude of programs and agencies.

The central feature of this legislation would enable aerospace firms to work together in a consortium to develop joint approaches to a variety of technological challenges ahead. This formula is modelled after the SEMATECH consortium, an ongoing Federal program that has helped restore the competitiveness of the semiconductor industry in a very short matter of time.

Mr. Chairman, in the hours ahead I have no doubt you will hear a great deal about the global competitiveness of U.S. aerospace industries, the importance of aerospace to our national and defense industrial base, and the continued need to keep America on the cutting edge of new technologies. All of these are central to the issue you will be taking up today and they deserve a good deal of consideration.

But in my time here this morning, Mr. Chairman, I want to concentrate on a different aspect of the problem. Not too long ago I had the opportunity to pay a visit to an engine component facility maintained by the Pratt & Whitney Corporation in Southington, Connecticut. This particular facility provides more than 1,300 jobs and is a critical part of the economy in that region of the state. Unfortunately, over the course of the next few years, this entire facility may be completely and permanently shut down.

When I visited this company I had the opportunity to hear from more than just the people who manage the books and make the high-level decisions in the corporate board room. I met with the men and women who punch the clock every day and put in their hours on the shop floor. I spoke to them about the circumstances they

face today and the challenges they expect to confront tomorrow. And what I heard was an outpouring of concern for their jobs, their families, and their futures.

Many of these working men and women have given the better part of their working lives to the U.S. aerospace industry. They have contributed greatly to the industrial capability and the national security of America. They have developed job skills and capabilities that would make them the envy of any modern corporation. And soon they may face the prospect of filing for unemployment.

Mr. Chairman, in Connecticut and across the Nation, these difficulties are magnified many times over. In 1989, there were 1,331,000 people working in the aerospace industry. By the end of 1993 that number will fall to roughly 990,000. In Connecticut we have lost about 13,000 aviation-related jobs in the past four years alone, at major corporations such as United Technologies and Hamilton Standard. And the fear among many is that these high-paying, high-skilled, high-value jobs may be gone for good.

Mr. Chairman, on a number of occasions I have talked to the working men and women at Pratt & Whitney's plant in Southington and in many other aerospace facilities across the state of Connecticut. These individuals have shared with me their thoughts as to how we should collectively address the challenges ahead. I would like to take this opportunity to share some of their more general concerns with you this morning.

First, any action we take must be done quickly and in a comprehensive manner. The challenges to the aerospace industry in this country take a number of different forms, ranging from the decline in defense spending to the growth of overseas competition to the continuing struggles of the commercial airline sector. We should keep in mind that all of these problems are related and that we cannot address one to the exclusion of the others.

Second, we should keep in mind the advantages as well as the disadvantages of competing in this increasingly global economy. We must take quick and lasting action to address the unfair and trade-distorting subsidies of the European Community. Of that there can be no doubt or disagreement. But we should try to do so in a manner that preserves our access to this crucial and rapidly growing export market.

Third, we must not allow our focus on the health of the industry to distract us from the pressing concerns that are faced every day by working men and women. Initiatives to increase industry's access to technology are important and should be undertaken. But we must also keep in mind that the best resource we can have in this country is a skilled and well-trained work force. We will simply not be competitive in this world if we do not address that half of the equation.

In conclusion, Mr. Chairman, I commend you for holding this hearing and for focusing the committee's attention on this very important subject. I urge the committee to move quickly to develop legislation that addresses the many challenges facing the U.S. aerospace industry today. And with all the very good reasons to take this initiative I urge the committee not to lose sight of the most important one of all: Preserving high-skill and high-value manufacturing jobs for the working men and women of America.

Once again I appreciate your invitation to appear before your committee this morning and I look forward to any questions you may have. Thank you.

Senator DORGAN. Senator Dodd, thank you for your excellent testimony.

Next we will hear from Senator Lieberman.

STATEMENT OF HON. JOSEPH I. LIEBERMAN, U.S. SENATOR FROM CONNECTICUT

Senator LIEBERMAN. Thank you, Mr. Chairman. I am glad to join our colleague here.

It is no accident that the two of us are here to support this bill, for the reasons that Senator Dodd made clear. The aerospace industry in America is in trouble, and that affects the jobs of a lot of hardworking, proud people in Connecticut and throughout this country who have built the finest aerospace products in the world and now feel that lead as well as their jobs slipping away from them.

This Aeronautical Technology Consortium Act of 1993 in my opinion, and I appreciate the leadership of Senator Danforth in this, forging a partnership between the public and private sector, really can not only get us back in the game but can really make us winners in the game for a long time to come.

The importance of a healthy U.S. aerospace industry simply cannot be overstated for America. Aircraft production alone affects nearly 80 percent of our economy directly or indirectly, and for each dollar of aircraft sales the Nation's economic activity is increased by \$2.30.

Aerospace exports comprise 10 percent of all American exports, making it the second largest export industry in our country. We simply cannot sit back, wring our hands, and let this vital industry, vital to our security and our economy, slide down the drain.

SEMATECH and the semiconductor industry really present us with an extraordinarily hopeful example, a precedent for how to make things better, so this Aeronautical Technology Consortium Act, which is the subject of this hearing, is not a theory. It is a policy which has worked for the semiconductor industry, and I just want to take a moment, Mr. Chairman, to briefly go over that story.

In 1981, the U.S. semiconductor industry comprised nearly 50 percent of the worldwide market and held a 15-percent lead over Japan. In 1981, in terms of semiconductor equipment sales, American firms held 75 percent of the market as compared to 20 percent for Japan.

Six years later, in 1987, Japan had taken the lead in semiconductor sales and was continuing to gain in equipment sales. 1987 was also the year that SEMATECH was created, and in the period of time since then we have quite simply stemmed the slippage and gained the advantage once again. The decrease in American semiconductor sales has become an increase, and the equipment manufacturers have had a remarkably similar turnaround.

That happened because of a consortium set up between semiconductor manufacturers and the Federal Government investing \$200 million, one-half from industry, one-half from Government, unprecedented cooperation, and helped restore U.S. chipmakers to world leadership in the \$63 billion semiconductor market, and also made sure that these chips that are so important to our sophisticated military hardware were not in the control of foreign manufacturers, which is not a position that any of us wanted to happen there, and we should not want it to happen in the aerospace industry as well.

Parallels between the semiconductor industry of the early eighties and the aerospace industry of these early nineties are unsettlingly graphic. Over the last 5 years, Boeing and McDonnell-Douglas combined market shares dropped from 78 to 67 percent, measured in new aircraft orders.

The Airbus consortium has captured 30 percent of the market for new orders, and has surpassed McDonnell-Douglas as the second largest civilian transport producer. Increased competition from Pacific Rim nations threatens to further reduce U.S. market share.

Mr. Chairman, the exceptionally high price tag associated with developing new aircraft and new aircraft engines only makes this

problem worse and makes this act more critically necessary. The R&D costs for new aircraft range from \$4 to \$8 billion. The R&D costs for the next generation of jet engines alone totals \$2.5 billion.

Enginemakers such as Pratt & Whitney in our State of Connecticut need to embark on a program to develop new engine technologies, including the use of new composites and advanced turbine designs, and they simply cannot do it alone.

The Government and the manufacturers would both be beneficiaries of the kind of joint effort prescribed in this legislation, and I want to reflect here today my understanding that it is not only the aircraft manufacturers who support this bill, but the jet engine manufacturers not only support it but are ready to participate in the consortium that it would create.

Mr. Chairman, we now have the opportunity to do for the aerospace industry what we did for the semiconductor industry, and it is critical to our national security and our economic health.

I thank you for holding this hearing. I do want to add one brief comment about the bill, which I think is a very good one. I would like to recommend, consistent with what Senator McCain said, that the bill language be modified slightly to allow smaller, short-haul commuter aircraft to be included along with the larger civil aircraft as appropriate purposes of the consortium established here, and that way this legislation can have a broader impact on this very important industry.

I thank you, Mr. Chairman. What you are doing here is probably as important as anything that will be done in this Congress for our economy and for the protection and creation of jobs. Thank you.

[The prepared statement of Senator Lieberman follows:]

PREPARED STATEMENT OF SENATOR LIEBERMAN

Mr. Chairman, thank you for calling this hearing today on the Aeronautical Technology Consortium Act of 1993. With this bill, we have the opportunity to demonstrate the commitment of the Federal Government to the aerospace industry, and to provide some real assistance to an industry that has been on the ropes for a number of years. We're all familiar with the statistics that so clearly illustrate the industry's influence on the nation's overall economic landscape. Aircraft production alone affects nearly 80 percent of the economy, directly or indirectly, and for each \$1.00 of aircraft sales, the nation's economic activity is increased by \$2.30. For each airplane built by Boeing or McDonnell Douglas, American workers across the country are producing the multitude of products that go into that airplane. Many of these suppliers are the small and medium sized firms that are hardest hit by difficult economic times. Aerospace exports comprise 10 percent of all US exports, making it the second largest export industry. The industry as a whole currently creates a positive trade balance for America in excess of \$28B. Further, the National Critical Technologies Panel has identified aeronautics as one of the 22 technologies critical to national economic prosperity and national security. Clearly, aerospace is a critical industry.

Mr. Chairman, rather than dwell on the ills that have befallen the aerospace industry, let me take a minute to draw a parallel with another industry that was on the brink of disaster, and was snatched from that brink by just the same Government action that this legislation would initiate for the aerospace industry. SEMATECH, created in 1987, has conclusively shown that a government-industry R&D consortium can help improve an industry's competitive posture by developing and commercializing advanced technologies.

In 1981, the U.S. semiconductor industry comprised nearly 50 percent of the worldwide market, and held a 15 percent lead over Japan, our closest competitor. In terms of semiconductor equipment sales, U.S. firms held 75 percent of the market, compared to 20 percent for Japan. By late 1985, however, those figures had dropped to 42 percent and 60 percent, respectively, and were on a steady downward slide. By 1987, the year of SEMATECH's creation, Japan had taken the lead in

semiconductor sales, and was continuing to gain in equipment sales. The U.S., especially within the defense community, faced the very real possibility of relying on foreign manufacturers for semiconductors, the electronic "chips" that run everything from coffee makers to the most sophisticated military hardware. Yet by 1991, four years after the establishment of SEMATECH, the decrease in semiconductor sales had become an increase, and the steady decline in equipment sales had reversed, with U.S. suppliers sales equalling Japanese suppliers.

How did this remarkable reversal of fortune come about? It came about through the establishment of a true partnership between government and industry, and through true investment in a critical industry—investment that has paid dividends and promises to continue paying dividends. In 1987, a consortium of semiconductor manufacturers, along with the federal government, invested \$200M, half from industry, half from government, in a ground-breaking experiment. Companies such as AT&T, Intel, NCR, IBM, DEC, and others, normally the fiercest of competitors, joined forces with each other and with the Department of Defense, the Department of Commerce, and the Office of Science and Technology in a fight to save billions of dollars and tens of thousands of high-skill, high-wage jobs. This level of cooperation was unprecedented, as were the results. In five short years, with a constant level of shared investment, SEMATECH has:

- Created a model partnership between private industry and the U.S. government;
- Kept jobs at home by making it possible to produce state-of-the-art semiconductors on all-American-made machines;
- Helped put American makers of semiconductor factory equipment back on top of a \$10 billion global market;
- Helped restore U.S. chip manufacturers to world leadership in the \$63 billion semiconductor market;
- Developed plans for future factory designs which will help bring the U.S. semiconductor industry and domestic manufacturing into the 21st Century;
- Generated 15 patents and 36 pending patent applications, helped enact 300 industry standards, participated in 110 equipment improvement and joint development projects and published 1,100 technical documents; and
- Energized one of America's critical industries like never before.

Mr. Chairman, the parallels between the semiconductor industry of the early 1980s and the aerospace industry of the 1990s cannot be ignored. Over the last five years, Boeing and McDonnell Douglas' combined market share has dropped from 78 percent to 67 percent, measured in new aircraft orders. The Airbus consortium has captured 30 percent of the market for new orders, and has surpassed McDonnell Douglas as the second largest civilian transport producer. Increased competition from Pacific Rim nations promises to further reduce U.S. market share. The costs associated with developing new aircraft is exceptionally high, and have been growing in real terms and in relative terms for years, as the technology has become more sophisticated. The R&D costs for new aircraft range from \$4.0B to \$8.0B. The R&D cost for the next generation jet engine alone totals \$2.5B. These costs will only increase as demands for technological advances rise. No single aerospace firm can afford these costs alone. As a result, U.S. firms have greatly curtailed R&D expenditures, or have turned to foreign partners to assist in financing the development of new aircraft. These alliances would shift a portion of the industrial base for the aircraft and for spare parts to countries such as Japan, Australia, and Singapore.

Mr. Chairman, the U.S. Government has the opportunity to do for the aerospace industry what it did for the semiconductor industry. The Aeronautical Technology Consortium Act of 1993 will foster cooperation among intense competitors engaged in manufacturing technologies, transfer and conversion of aeronautical technologies developed for national security purposes to commercial applications, and development of subsonic and supersonic aeronautical technologies applicable to the production of civilian aircraft. Jet engine manufacturers in particular need to embark on a program to develop new engine technologies, including the use of new composites and advanced turbine designs. The Government and the manufacturers would both be the beneficiaries of such a joint effort, and my understanding is the the manufacturers are ready to participate.

This act will coordinate Federal aerospace programs, focusing resources to assist industry-led initiatives. There are billions of federal dollars spread among the Air Force, the Navy, DARPA, the National Institute of Standards and Technology, the FAA, NASA, the National Science Foundation, and our Federal Labs. This act will focus those resources to catalyze industry-led technological advances that will contribute to the strengthening of the industry. Using the highly successful SEMATECH consortium as a model, "Aerotech" can achieve for the aerospace industry the successes achieved for the semiconductor industry.

Mr. Chairman, this bill has a great deal of merit. I would like to recommend, however, that it be modified slightly to allow smaller, short-haul commuter aircraft to be included, along with large civil aircraft. This minor modification will allow the bill to have a broader impact on this very important industry. This bill is a first step in revitalizing this industry that is so critical to our economic success. We cannot afford to wait until technological leads have disappeared, as happened in the semiconductor industry. The goals of this bill are consistent with the goals of the Administration—investing in technology; strengthening America's industrial competitiveness; encouraging business development in areas that will expand the number of well paying jobs; and developing a true partnership between the federal government and industry to ensure America's pre-eminence in the global marketplace.

Senator DORGAN. Well, thank you very much for the testimony. I think what both of you presented was excellent.

When I first arrived in Washington in 1981 over on the House side, I recall walking into the office of Claude Pepper for the first time to say hello. He had two pictures behind his chair on his wall.

One was an autographed picture to him of Orville Wright making the first airplane flight, autographed. Orville signed it before he died, I guess. Below that was an autographed picture of Neil Armstrong standing on the Moon, and that describes the enormous leadership and burst of technology we have had in this country in this area, and I think you make the point that just like in television, we invented television, and those who might watch part of this hearing will watch it likely on a set that we did not manufacture.

You make the point that even though we have been the pre-eminent world leader in this industry, the manufacture of airplanes, we are threatened by having most of these airplanes in the long term, if these trends continue, made elsewhere.

A professor of MIT wrote an article I read recently, and he makes the point that the Federal Government's investment in research and development, particularly in defense, used to apply more directly to aeronautics. He says now the U.S. defense budget with respect to research and development in these high-technology areas has veered more into high-technology exotica such as Star Wars, which has less application to aeronautics, and less application to commercial aviation, and he makes the same point about the space program.

I know Mr. Goldin is here, and we will probably hear from him on that subject, but do you have any comment on that, in terms of what our defense budget has done and what NASA has done in terms of what can be applied to the commercial aviation industry?

Senator DODD. Well, I know if you go back and look, and I do not know about those numbers specifically, but for many years it was the research dollars in the defense industry which drove a lot of the changes which have occurred in the commercial areas, generally speaking.

Somewhere around 1980 or so that changed, and the technology, the new innovations were occurring as a result of R&D dollars in the commercial sector, and among our competitors in that area we are lagging.

The assumption was that one of the benefits to defense spending was the prospect of commercial spinoffs, and there was certainly some truth to that, and certainly defense dollars in our case at home made a great deal of difference in terms of building the prototypes and played on the cutting edge in this area. And clearly

with the decline now in these dollars, as we are going to see, it raises new problems in terms of how we play a role, as Senator Lieberman has said, and I think accurately so, how you form that partnership here, because the costs are staggering.

I mean—and Joe, correct me if I am wrong in this—but if you were to just invest to design a new jet engine, roughly the cost is \$2 billion.

Senator LIEBERMAN. That is correct.

Senator DODD. \$2 billion if you were to start to develop a new jet engine today for the future, the next 4, 5, 6, 7, 10 years. That is an extraordinary amount of resources to invest in something that may or may not work, and may or may not have a market out there.

So, it is a different game today, entirely, from what it was even a few years ago. Hence, you see a lot of the consortiums, the joint venturing. It has to be done. The capital just does not exist in these individual companies to be able to engage in that, so the partnerships here are absolutely essential.

Senator LIEBERMAN. And of course, part of the premise of this legislation is that the partnerships exist in our competitor nations, so if we are sitting back and saying to our aerospace companies, go ahead and do it yourselves, we are really consigning them and us to defeat, because in Europe and Asia the governments are helping the aerospace companies because they know that they cannot do it independently.

The other part here is that there is going to have to be—and this bill can help stimulate it—some unprecedented cooperation among aerospace manufacturers themselves just the way people in the chip business and the semiconductor business have cooperated in an unprecedented way in SEMATECH.

Let me come to your question briefly, Mr. Chairman, which is that in addition to creating Aerotech, this legislation makes much more formal the cooperation between the public and private sectors in the assignment and commitment of Federal defense dollars so that what has happened informally over the years, which is that defense spending has really had enormous commercial spinoffs, will be much more guaranteed.

To just state it succinctly, this bill requires that the civilian—that the commercial interests, the aerospace industry, be at the table with the folks in the Defense Department as they make their R&D priority decisions so that they are being made not only on the basis of national security, which obviously has to remain the priority, but they are being made also on the basis of which are the investments that will most likely have the best commercial spinoffs and therefore help our economy most.

You are having Bill Perry testify today. I think we are fortunate in having Bill Perry as the Deputy Secretary of Defense, because I do not know of anybody who has written more about the importance of joint private-public sector activities here and who knows more about it and in that sense is more committed to it.

So, we are very fortunate to have the coming together of a good idea, which Senator Danforth has taken the lead on and we are happy to work with him on, and someone in the administration who I think has really to run with this if we put it in place.

Senator DORGAN. Senator Danforth.

Senator DANFORTH. Mr. Chairman, I have no questions. I would only like to express my appreciation to Senator Dodd and Senator Lieberman for really excellent testimony and for your support of this legislation.

Senator DORGAN. Senator McCain.

Senator MCCAIN. I would just like to thank both Senators for a very excellent presentation, and I think they will continue to play a very important role as we address this issue. And I thank both of them for lending the sense of urgency to this issue that it deserves. Thank you, Mr. Chairman.

Senator DORGAN. Senator Lott.

Senator LOTT. No questions, and I apologize for not being here for their statements. I know it was very good, and I appreciate our colleagues being here this morning.

Senator DORGAN. Senator Gorton.

Senator GORTON. I am delighted to hear these good words about matters of great interest to this Senator and this committee, and it is wonderful to have our two friends from Connecticut here to make this excellent presentation.

Senator DORGAN. We thank you very much for your testimony.

Senator LIEBERMAN. Thank you.

Senator DODD. Thank you.

Senator DORGAN. Next, we will call on the first panel that will testify on this subject, Mr. Timothy Hauser, Acting Undersecretary for International Trade, the Department of Commerce; the Honorable Daniel S. Goldin, Administrator, National Aeronautics and Space Administration; and Dr. William J. Perry, Deputy Secretary of Defense. We would ask you to come forward and take seats at the table.

We will ask that your full statements be made a part of the permanent record and that you would summarize for this committee the statements. And we would ask for a 5-minute summary, if you can, so that we have plenty of time left for questions.

We will first call on Dr. Perry, Deputy Secretary of Defense.

STATEMENT OF WILLIAM J. PERRY, DEPUTY SECRETARY OF DEFENSE

Dr. PERRY. Thank you, Senator Dorgan.

Today, the American aircraft industry is the world's leader, both in technology and competitiveness. The issue facing this panel today is whether it will remain so in the future. I would like to start off by saying that I believe it is vitally important for our national security that our aircraft industry sustain its position as the world's leader.

I believe there are four factors that affect this importance: first, the Department of Defense's continuing need for superior military aircraft; second, the Department of Defense's commitment to pursuing high payoff aeronautical technologies toward that end; third, the fact that the technologies are dual use; and, fourth, the strengths of the relationships among DOD and NASA on the one hand and the industry on the other. I would like to briefly address each of these four points, since I think they bear critically on the question you are considering today.

The first has to do with the Defense Department's strategy, which will continue to be based on having the world's best military aircraft. We see no alternative that offers the combination of fire-power and mobility to that provided by aircraft. But the continuing importance of military aircraft requires a strong aircraft industry.

In this regard, I do not believe the industry should be viewed on the one hand as a defense aircraft industry and on the other hand as a civil aircraft industry. These two aircraft types have too much in common for such a view, and we should regard the industry as an indivisible industry. Therefore, the standing of the aircraft industry in the civil marketplace is of utmost importance to the Defense Department.

The second point I would make is that the continuing need for superior military aircraft dictates that the Department pursue aggressive science and technology efforts. Our fiscal year 1994 request for aeronautical science and technology funding is almost one-half billion dollars. That is in the technology end, not on the development of specific systems.

The third factor, and a very critical factor in this consideration, is the dual-use nature of the majority of our technology efforts, and that these efforts, these technology efforts, are conducted largely by the aircraft industry, not in our Department of Defense laboratories. Accordingly, the technology resides primarily in industry and is available both for military and civil applications.

I do not mean to suggest that the transfer of this technology poses no difficulty. The point I want to make is that the primary issue is the transfer within industry, not a transfer from Government to industry.

The fourth point is that there already exists considerable coordination, both formal and informal, between DOD, NASA, other Government agencies, and industry. In particular, there is a longstanding and continued cooperation between DOD and NASA in aeronautical technology development. This cooperation can be and will be improved, however.

Now, considering these four points, I would like to make some specific comments about the proposed consortium. In principle, I support the concept of consortia as mechanisms for both focusing resources and for leveraging Government investment through costsharing with industry. There are several criteria that I believe are important for direct DOD support of such consortia. These criteria are based on the lessons we have learned from the experience we had with the SEMATECH consortium, which I consider to be a success.

Now, the first point that we learned from SEMATECH is that the leadership must come from industry, and the second is that the industry should have a program agenda prior to formalizing the relationships among the members. In SEMATECH, the leadership did come from the industry. They started off, however, without that agreed agenda, and there was, I think, a year or two of lost time in getting SEMATECH started as a result. And we should benefit from that experience.

Finally, they need a sharply focused program. SEMATECH started off with quite a diffused set of research activities, and they learned that it was necessary to focus. In the case of SEMATECH

they focused on manufacturing process technology in microelectronics.

With these lessons in mind, then, I would offer several suggested criteria for the consortium being considered here. The first is that the consortia must be led by industry, and that it must be costsharing. Industry is in the best position to make judgments about what efforts will have the most potential impact in the civil marketplace. And the related costsharing is evidence that those judgments have been applied.

The second criteria is that the activity should encompass market pull rather than technology push. This would include explicit attention to manufacturing processes. Indeed, based on SEMATECH, it may be that manufacturing process technology offers the most fruitful area for consortium research and development.

Third, the consortia activity should have the potential to benefit all participating firms in the relevant segments of the aircraft industry.

And finally, I believe that the sponsorship for this consortium within the Government should be administrationwide.

With these criteria, let me also offer a few concerns about the consortium which should be taken carefully into account before such a consortium is launched. It may be very difficult for the Government and industry to agree on the membership, particularly in an industry as diverse as the aerospace industry or the aircraft industry, much more diverse than the semiconductor industry. I believe that it would actually be better for the industry to take the full leadership in determining its membership rather than have the Government participate in it.

Second, it may be difficult to agree on a program of significant scope for the consortium, again considering the diverse nature of the aircraft industry. Based on our experience with SEMATECH, I would suggest that an industry-led focus on manufacturing processes may be the answer to that problem.

I realize that the outcome of this proposal cannot be predicted with certainty. However, I would like to summarize by saying that I believe that the aerospace technology consortium is a very interesting idea, and it is worth serious consideration by the Congress. In that consideration, I suggest you look very carefully at the lessons learned from SEMATECH, some of which I have summarized here for you, and that you also consider recommendations from the newly formed national commission on the aviation industry.

Finally, I would like to summarize my own suggestions for how this consortium should be put together. First, that the concept be broadened to include commuter aircraft as well as large civil aircraft; second, that the industry take the leadership in forming this, and in the absence of industry leadership I would question whether you should proceed with it; and third, that industry establishes in the beginning a very sharp focus on what the R&D program should be. In my own judgment, the best candidate for that would be a focus on manufacturing process technology and manufacturing standards.

Thank you, very much.

[The prepared statement of Dr. Perry follows:]

PREPARED STATEMENT OF WILLIAM J. PERRY

I'm pleased to offer my views on the proposed legislation, and more generally, on the nature of the problems that it addresses. The Department of Defense certainly supports the intent of the legislation, namely to strengthen and assist the United States commercial aircraft industry. The vitality and competitiveness of our aircraft industry has been outstanding for many years, and it is important to the Department of Defense that it remain so in the future.

I believe we would all agree that any successful effort to enhance the competitiveness of the aircraft industry will recognize, and capitalize on, the Department's continuing need for superior military aircraft, its commitment to pursuing high-payoff aeronautical technologies toward that end, the dual-use aspects of these technologies, and the strengths of existing relationships among DoD, NASA, other Federal agencies, and the industry. So before addressing the specifics of the proposed legislation, I think it may be useful to discuss these four areas.

DOD NEED FOR SUPERIOR MILITARY AIRCRAFT

First, superior military aircraft continue to be essential. The Department of Defense continues to devote about one-third of its budget to the research, development, procurement, operation, and support of aircraft. Further, there are no alternatives on the horizon that offer the combination of firepower and mobility provided by aircraft—aircraft will remain an important part of the force structure for the foreseeable future. It is true, of course, that force structure and force modernization efforts are being reduced in accordance with the world military environment, and these reductions apply to aircraft—for example, our aircraft procurement account has decreased from about \$37 billion in Fiscal Year 1985 to about \$15 billion in Fiscal Year 1994, which is comparable to the decline in our overall procurement account. But the shift in military environment to potential regional conflicts of uncertain origin against well-equipped adversaries does not diminish the relative importance of aircraft in the force structure. DoD will continue to need the world's best aircraft.

The continuing need for superior military aircraft dictates, as pointed out in the proposed legislation, a strong aircraft industry. I do not believe the industry should be viewed as a "defense aircraft industry" separate from the "civil aircraft industry". Although civil aircraft are generally quite different from military aircraft, they have much in common: many technologies; many manufacturing processes; at the subsystem level, certainly, many components; and many corporate entities are engaged in the manufacture of both civil and military aircraft and their components. Accordingly, I believe the aircraft industry should be viewed as rather indivisible, serving both military and civil purposes. Regardless of whether this has been a widely held view in the past, it will surely be a widely held view in the future, given the decline in defense procurement. It follows that the aircraft industry's standing in the civil marketplace is of utmost importance to the DoD, since it is the base from which we obtain our aircraft, and since its market-share position dictates its relative ability to invest in dual-use technologies important to DoD. As a result of this importance, we are aggressively pursuing changes in our acquisition practices to remove barriers to further civil/military integration in the industry, and we will consider more intensely the military and civil benefits of potential aircraft developments in the future.

DOD COMMITMENT TO AERONAUTICAL TECHNOLOGY DEVELOPMENT

The continuing need for superior military aircraft also dictates that the Department continue to pursue aggressive science and technology efforts in high-payoff aeronautical technologies. The need for continuing such efforts may be questioned by some, given the precipitous decline of our aircraft procurement account. However, a significant characteristic of aircraft development, be it for new aircraft or upgraded aircraft, is the length of the process; it is usual for relevant technology efforts to be conducted 5 to 15 years, or perhaps more, in advance of the first appearance of the finished product. Due to the length of this process, as well as future uncertainties, the payoffs offered by aeronautical technology, and the fact that productive technology efforts can not be turned off and on at will, it is essential to continue these efforts. We are committed to this continuation, and the Department's Fiscal Year 1994 request for aeronautical science and technology funding reflects this commitment; we have requested somewhat in excess of \$450 million. These efforts obviously cover a broad spectrum, including those aimed at higher performance, more affordable turbine engines; lighter weight structures; reduced drag via laminar flow control or other means; integrated flight/propulsion control systems; electrically powered subsystems; reduced signatures; design automation to reduce development

cost and time; and advanced manufacturing techniques to reduce manufacturing costs. In addition, we have identified aeronautical technologies as one of the eleven technology focus areas in the Technology Reinvestment Project; since its announcement, we have had dialogue with numerous potential project participants from the aircraft industry, and our expectations of winning ideas from industry are high. There should be no doubt that DoD is committed to developing aeronautical technologies.

DUAL-USE ASPECTS

The majority of our technology efforts, although aimed at high-payoff military goals, are dual-use in nature, due to the commonality of technology for military and civil applications. There are of course some differences: technology associated with stealth is, at least up to the present time, distinctly military in character; and technology associated with environmental concerns receives much more emphasis in the civil arena. Still, the majority of the technology is common to both military and civil applications.

An important characteristic of DoD's aeronautical technology efforts, which bears on technology transfer between civil and military applications, is that the vast majority of these efforts are conducted by the aircraft industry—it is the industry that generates most of the technology, not the DoD laboratories. Accordingly, the technology resides in industry. Further, since the airframe manufacturers, the engine manufacturers, and the suppliers are, to a large extent, involved in both civil and military markets, the technology is available for both military and civil applications.

History indicates that the technology is indeed used for both applications. DoD-initiated technology efforts have contributed to civil aircraft in many areas: composite materials and structural integrity, digital flight and engine control, active matrix liquid crystal displays, ring-laser gyroscopes, and gas-turbine engines, to mention a few. Aircraft gas-turbine engine technology is a particularly good example of this technology transfer between military and civil sectors. In the past, this transfer has been not only of technology, but in many cases, major subassemblies as well. The CF6 engine, which uses the core of the military TF39 engine, and the CFM56 engine, which uses the core of the military F101 engine, are two examples, but there are many more. More generally, virtually every large US civil aircraft engine has its origins in a military engine and/or military technology programs.

These examples are not meant to suggest that technology transfer poses no difficulties. They do indicate, however, that the most important question is not how to transfer technology from DoD to the industry, but rather how to transfer the technology from one corporate entity to another, or in many cases, from one segment of a corporate entity to another segment of the same corporate entity.

EXISTING RELATIONSHIPS BETWEEN DOD, NASA, OTHER GOVERNMENT AGENCIES, AND INDUSTRY

The dual-use nature of aeronautical technology, and DoD's role in its development and application, have led to considerable coordination between DoD, NASA, DoE and other government agencies, and industry. In particular, there is longstanding and continuing cooperation between DoD and NASA in aeronautical technology development. Although I understand that the senior coordinating body, the Aeronautics and Astronautics Coordinating Board, has not met for some time, considerable effort continues to be devoted at all other levels to ensure that our programs are complementary, and that they address the needs in our respective mission areas. These efforts also lead to cooperative technology efforts between DoD, NASA and DoE; currently, there are over 125 such efforts with NASA. In addition, we expect to continue to demonstrate successful interagency collaboration in efforts such as the Technology Reinvestment Project, which has been a fully collaborative effort with the Departments of Commerce and Energy, NASA, and the National Science Foundation.

One specific program that perhaps deserves some discussion is the Integrated High Performance Turbine Engine Program (IHPTET), because it does illustrate one way in which government and industry can work cooperatively in an effort that will contribute significantly to both military superiority and civil competitiveness. Our request for the IHPTET program in Fiscal Year 1994 is \$133 billion. The program was initiated in Fiscal Year 1988, aimed at specific and aggressive goals for all military engine classes in three time-phased steps. The program was undertaken in recognition of the large impact of engine performance on the cost and capability of military aircraft. It is a planned, coordinated program among the Army, Navy, Air Force, ARPA, NASA, and industry. There is one government plan, and each of the seven aircraft engine manufacturers has a complementary plan that addresses the

IHPDET goals in their market segments. Progress has been good, and industry funding devoted to the IHPDET goals has slightly exceeded the government funding to date, although there has been no formal requirement to do so. The government has encouraged, and continues to encourage, pre-competitive technology cooperation among the manufacturers with some success—the most notable example is that all seven engine manufacturers have formed a consortium to pursue the development of fibers for advanced composite materials. We believe IHPDET is in many ways a model technology program: it incorporates effective strategic planning and implementation, DoD/NASA coordination, and government/industry cooperation in an area vital to the aircraft industry. NASA and DoD are currently actively coordinating NASA's planned augmented aeropropulsion initiatives to ensure that both IHPDET and these initiatives will maximize technology development for both military and civil purposes.

AERONAUTICAL TECHNOLOGY CONSORTIUM ACT OF 1993, S. 419

With regard to the proposed legislation, I should first note that a "National Commission to Ensure a Strong, Competitive Airline Industry" has just been convened to review all major aspects of the aviation industry, including technology issues. I urge you to consider the findings and recommendations of the Commission before acting on this legislation.

As to the specifics of the proposed legislation, I fully support coordination of aeronautical technology activities among the Federal agencies and industry. Such coordination is essential to maximize the benefits obtained from our collective investment, and is important at any time; given our present economic environment, it is absolutely vital now. However, I believe establishing the proposed Coordinating Committee may be premature. Pending the results of the Commission, I understand that the Office of Science and Technology Policy (OSTP) already intends to create appropriate interagency coordination mechanisms, based upon an assessment of the substantial coordination that already exists. I suggest you may wish to afford the Director of OSTP such an opportunity, rather than mandate the proposed Aeronautical Technology Coordinating Committee.

The proposed Aeronautical Technology Consortium is an interesting approach, and it has many implications. As I understand the Bill, it would create one rather large consortium—composed of firms involved in any or the many aspects of the aircraft industry—to conduct industry-led joint ventures relating to aeronautical technology, including manufacturing technologies. I also gather that the ultimate membership is to be approved by the proposed Coordinating Committee.

In principle, I support the concept of consortia as mechanisms to focus resources, eliminate unnecessary duplication of pre-competitive technological effort, and leverage government investment through cost-sharing with industry in specific areas. There are several criteria that I believe are important for direct DoD support of consortia in the aircraft sector, and I would like to discuss them briefly, and then append my assessment as to the extent the proposed consortium might satisfy them. These criteria are based on some lessons learned from SEMATECH. The most important of these lessons is that the consortium establish a program agenda prior to formalizing relationships among the members. Some key factors that must be considered are:

- All participants must sort through pre-competitive issues. In structuring SEMATECH, we discovered it was critical to focus on manufacturing technology and processes instead of creating specific products.
- It is very important to focus the program so that it is bounded; the range of issues to be addressed must be limited. In the case of SEMATECH, we have focused on manufacturing technology for microelectronics.

I should probably say at the outset that there do not appear to be any easy answers to the many questions that arise.

The criteria that I would suggest include the following:

- Consortia must be led by industry; the desired technical programs should be generated by largely by industry, and should involve some cost sharing. Since we are endeavoring to impact the civil marketplace, industry is in the best position to make judgments about what efforts will have the most potential impact. The related cost-sharing is evidence that the desired and necessary industry judgment has been applied.
- The activities undertaken by consortia should encompass "market pull", rather than only "technology push." These would include explicit attention to manufacturing processes, as well as technology generation. Indeed, manufacturing processes may be the most fruitful area to pursue. I would also anticipate that these activities would encompass what we in DoD refer to as technology demonstrations—proof that

the risk of the technology or the manufacturing process is sufficiently low that it can be committed to product development. This is particularly important given the decline in DoD's aircraft development activities. Although DoD technology efforts provide proof that dual-use technology is ready for military system development, the desired proof for commercial application is generally somewhat greater, and our aircraft development activities have partially served as proof of sufficiently-low risk for commercial application of a variety of technologies.

- Consortia activities should have the potential to benefit all participating firms in the relevant segments of the aircraft industry. This implies that explicit attention is devoted to technology transfer. As stated earlier, from the DoD view the largest problem in technology transfer is the transfer within industry. Consortia imply greater technology cooperation, and hence enhanced transfer, within the membership; on the other hand, many potential members are still competitors with a desire for cooperation in only limited areas.

- Consortia sponsorship should be Executive-branch-wide, as I believe the Bill proposes. In particular, DoD support should be commensurate with the anticipated benefits to national defense. These benefits are admittedly difficult to measure, specifically in the context of the undeniable value to DoD of a healthy aircraft industry. More pragmatically, in this area, one obvious measure is the extent to which consortia activities could subsume, or otherwise be a source of leverage for selected DoD aeronautical technology efforts.

I will frankly state that there is no single ideal consortium that can satisfy all of these criteria to the maximum desirable extent; tradeoffs are obviously involved. With this in mind, let me state a few concerns regarding the proposed Aeronautical Technology consortium. Possibly the largest concern is the concept of a single consortium that encompasses an industry sector as broad as the aircraft sector; it encompasses many manufacturers and suppliers, and many different subsystems, components, manufacturing processes, and technologies. The implications with regard to suggested criteria appear to be as follows:

- It may be difficult for the government and industry to agree on the membership, and therefore to obtain the desired degree of industry leadership. It may also be difficult to get agreement on a program of significant scope for the consortium. Given the breadth of interests, and the fact that what constitutes a pre-competitive effort to one group of members may constitute a competitive effort to another group of members, the most likely areas of agreement will be in long-term research projects that do not impact the nearer term competitive position of any of the members. If the programs are long-term in nature, it will also be difficult to obtain significant support from industry. The IHPTET Fiber Consortium provides a microcosm of the probable process; although it is a laudable achievement, it required two years for the seven manufacturers to agree on the principle and on their relative contributions of the industry share of about \$7 million for a five-year period. Drawing from our experience with SEMATECH, an industry-led focus on manufacturing processes may be a possibility.

- It may be difficult to obtain a reasonable amount of "market pull", due to the tendency of agreed upon efforts to be long term in nature. Market pull is a fairly near term influence—say about 5 or so years to product introduction—and it impacts members' competitive positions. Efforts of these types—primarily technology demonstrations—would make it much easier to obtain significant cost-sharing, but obtaining agreement on a set of such efforts across the entire industry will be difficult. Once again, the breadth of interests makes it difficult to define a broad market-driven area that all members could view as pre-competitive. Here again, it is essential that industry take the lead, and sort through the pre-competitive issues. As with SEMATECH, manufacturing processes may serve as a focus of common interest.

- The single consortium does have the advantage, I believe, of minimizing technology transfer difficulties. Certainly with all members participating, and agreeing on the programs conducted, there should be a maximum degree of cooperative technology development and transfer.

You may wish to consider the alternative of providing for multiple consortia in the aircraft industry, to be formed entirely by industry's preferences. This would have the potential of a greater degree of true industry leadership, and a more significant total program with greater cost sharing and greater market pull. On the downside, it would demand significant attention to technology transfer.

As I said earlier, there do not appear to be any easy answers, and I will be very interested in the findings of the President's Commission in this regard.

Senator DANFORTH. Thank you very much, Dr. Perry. Mr. Hauser.

STATEMENT OF TIMOTHY J. HAUSER, ACTING UNDER SECRETARY FOR INTERNATIONAL TRADE, DEPARTMENT OF COMMERCE

Mr. HAUSER. Thank you, Mr. Chairman, and members of the committee, for providing the Department of Commerce the opportunity to discuss the competitiveness of the U.S. aircraft industry, as well as our views on S. 419.

The U.S. aircraft industry stands out as one of America's most successful industries, as we all know. But at the same time, the industry is facing some very difficult challenges. The three key issues we see confronting the industry at this point are continuing defense cuts, increasing international competition, and short-term stagnation but long-term growth in the commercial aircraft market. The sector has historically relied on the Department of Defense for a large portion of its revenues. With defense spending on the decline, the commercial aircraft sector represents the foundation and future of the industry.

However, there are challenges in this sector, as well. The U.S. industry will continue to face fierce competition from Airbus, and is seriously being affected by the current weak financial position of the U.S. airline industry. In contrast with the current sluggish situation, however, longer term forecasts are optimistic for growth in aircraft sales, particularly in the expanding economies of Asia and the Pacific Rim.

The United States is the global leader in large transport aircraft, producing over 70 percent of the aircraft delivered in 1992, and exporting some 22 billion dollars' worth of aircraft around the world. The two U.S. manufacturers, Boeing and McDonnell-Douglas, established this leadership by taking risks and by investing their own money in research and development and in plant and equipment. On research and development alone the two companies spent a total of over \$11 billion during the past 15 years.

The industry is currently adapting to the changes taking place. Defense cuts are forcing significant restructuring at McDonnell-Douglas and reallocation of resources at Boeing. Both companies have announced a large number of employee layoffs resulting from these cutbacks.

Despite a short-term softness in the world's airline industry, the aircraft manufacturers do anticipate long-term growth in the industry, particularly in long-range aircraft. The forecasts predict a huge worldwide large transport aircraft market over the next 20 years, some 13,000 aircraft. That represents twice the number of aircraft delivered by U.S. manufacturers over the past 20 years.

Despite the optimistic outlook for the long-term market, the U.S. industry will continue to face fierce competition from Airbus. It is estimated, as you mentioned earlier, Senator, that the Airbus governments, France, Germany, the UK, and Spain, have provided some \$26 billion in subsidies, including interest, to the development and production of Airbus aircraft. These subsidies have enabled the Airbus consortium to develop and introduce a family of transport aircraft, to avoid commercial risks, and to become the No. 2 company in the global industry after Boeing.

Our strong desire is for Airbus to compete on commercial and technical terms and not rely on Government subsidies which con-

tinue to undermine the U.S. industry and distort international competition. A step in the right direction was achieved with the July 1992 signing of a bilateral agreement which disciplines Government supports provided to the large civil aircraft sector.

The U.S. Government and our industry view this bilateral agreement as a first step toward the progressive reduction of direct government subsidies to Airbus. The United States is currently seeking further strengthening of these disciplines through multilateral negotiations in the GATT, which are expected to continue through 1993 and possibly beyond. Examples include seeking a further reduction in the level of government support allowed on new aircraft programs and adoption of a stronger dispute settlement mechanism.

Suppliers to Boeing and McDonnell-Douglas face some of the same challenges as the aircraft companies, themselves, such as declining defense spending and variability in the commercial aircraft industry. But suppliers, and here I am speaking primarily of aircraft, not engine suppliers here, face some unique problems. The most important of these is the globalization of the large transport aircraft. Since the early 1980's Boeing and McDonnell-Douglas have increased the percentage of foreign products installed on their aircraft, primarily for three reasons.

First, to gain access to international markets. Until recently, almost all airlines outside the United States were at least partially government owned. Governments insisted that their airlines demand that local companies get contracts for spare parts or original equipment on the aircraft they buy. Second, our companies sought more efficient and lower cost producers of certain products to help them remain competitive. Third, they undertook these efforts to gain access to foreign investment, a critical element in this very high-cost, high-risk industry. Foreign suppliers, often having a lower cost of capital, longer term strategies, and encouragement from their governments, have been willing to become large risk-sharing partners on new aircraft.

The U.S. Government can support the aircraft and aircraft suppliers industry by ensuring a domestic environment favorable to the international competitiveness of all U.S. industries. Our companies should not be at a financial disadvantage when contemplating difficult, risky, product development.

The Government must also invest more in basic and applied research that increases the competitiveness of all U.S. companies, including the aircraft manufacturers. As this committee is well aware, the Department of Commerce, through our National Institute of Standards and Technology, is promoting the effective commercialization of new technologies. We are also sponsoring programs such as the industry-led advanced technology program to assist U.S. businesses in carrying out R&D on precompetitive generic technologies.

Commerce also is helping the U.S. aircraft industry improve its competitiveness through technical assistance, ensuring fair competition in the international marketplace, and helping our producers enter new markets here and abroad. One recent initiative in this regard was an April 14 meeting that Secretary Brown and some of my copanelists, including Secretary Perry, attended with

the CEO's from the major aerospace companies and their trade association to discuss the issues facing the industry.

A second initiative was a recent trip by the Secretary the week before last to Saudi Arabia to press the interests of the U.S. aircraft manufacturers in a major \$6 billion competition underway in that market.

As has been noted previously, the current weak financial position of the U.S. airlines directly affects the short-term viability of our manufacturers by resulting in the cancellation or postponement of orders and by diminishing the domestic market base. We look forward to the efforts by the national commission to help ensure a strong, competitive airline industry, and I believe that some of the conclusions coming out of that effort will color some of our approaches in the context of this proposal.

On the specifics of S. 419, we believe it has the very commendable objective of fostering defense conversion and helping translate Government-funded technologies into commercially viable products. It is also a very good example of a kind of public-private sector partnership we wish to encourage.

There are a couple of concerns with the bill. One, while it is true that increased efforts can be made to improve the coordination among the Federal agencies involved in aeronautical research and technology development, many of the activities proposed in the bill are already being conducted by my colleagues, both at NASA, DOD, the FAA, and other agencies. NASA, we know for example, is already working closely with the U.S. aircraft and engine manufacturing companies on various research projects to help develop technologies required for a high-speed civil transport, commercially viable segment of the industry.

Second, with respect to SEMATECH, I would raise the question whether given the kind of timeframes involved—we are talking about a 5-year timeframe in this legislation whereas many aircraft development programs take as long as 10 years to come from the drawing boards into fruition—whether the SEMATECH model which focuses on an industry with a much shorter product development and life cycle is necessarily the best model to build on.

Third, as the U.S. industry becomes more global in nature and some U.S. manufacturers begin to enter into strategic alliances with Japanese and European companies, the bill's language regarding participation by non-U.S. companies could limit the formation of some of these strategic alliances.

In conclusion, while we support the intent of S. 419 to assist the U.S. industry in meeting current market challenges, we believe some of these areas do need further clarification, and would very much look forward to working with the committee in developing that clarification.

Thank you, sir.

[The prepared statement of Mr. Hauser follows:]

PREPARED STATEMENT OF TIMOTHY I. HAUSER

Good morning, Mr. Chairman and Members of the Committee. It is my pleasure to be here today to discuss with you the state of the U.S. aircraft industry and our comments on S. 419, the Aeronautical Technology Consortium Act of 1993. We look forward to working with you on improving the competitiveness of our country's aviation industry.

Mr. Chairman, the U.S. aircraft industry stands out as one of America's most successful industries, but, at the same time, this industry is facing some difficult challenges. The three key issues confronting the U.S. aircraft sector are: continuing defense cuts, increasing international competition, and short-term stagnation but long-term growth in the commercial aircraft market.

Still a global leader, the U.S. aerospace industry is a critical part of this country's export and domestic economies. The aerospace industry is the nation's leading exporter of manufactured goods, sending abroad products worth an estimated \$45 billion in 1992 to 181 countries around the world. The aerospace industry produces the largest trade surplus of any industry, approximately \$31 billion in 1992. That trade surplus is equivalent to 37 percent of the 1992 merchandise trade deficit. Aerospace is also a leading technology driver, utilizing a number of the technologies identified as critical by the White House Office of Science and Technology Policy, the Department of Defense, and the Department of Commerce.

The aircraft sector is the dominant and driving Segment of the aerospace industry. Aircraft, engines and their parts represented 78 percent of aerospace's shipments, 73 percent of its employment, and 95 percent of its exports in 1992. With defense spending on the decline, commercial aircraft represent the foundation and the future of the industry.

STATE OF THE LARGE TRANSPORT AIRCRAFT INDUSTRY

The United States is the leader in the global market for large transport aircraft. U.S.-built aircraft make up almost 80 percent of the world's fleet (excluding the former Soviet Union). The two U.S. manufacturers, Boeing and McDonnell Douglas, delivered 72 percent of the large civil aircraft sold to the world's airlines in 1992. The two companies exported an estimated total of \$22 billion worth of aircraft in 1992, but now orders are declining in reflection of the current financial difficulties faced by the airlines. U.S. aircraft manufacturers maintain 68 percent of the current world backlog of firm orders for large aircraft, with Boeing holding 59 percent of the backlog while McDonnell Douglas has 9 percent. Airbus has established a firm control of the number two position with 32 percent. While the U.S. firms still employ 220,000 workers, employment is down 60,000 from the 280,000 workers in 1991 and continues to shrink. In 1993 alone, Boeing announced planned layoffs of 28,000 workers and McDonnell Douglas announced an additional 10 percent workforce reduction, trimming its 1991 workforce by a total of 22,000 or 27 percent.

Leadership in the large civil aircraft sector has not come cheaply for either Boeing or McDonnell Douglas. In fact, over the last 15 years, the two companies have invested over \$11 billion in research and development. They have built their assets up from \$4 billion in 1976 to almost \$32 billion in 1992.

Short-term Prospects for the Large Transport Aircraft Industry

The future prospects for this sector are mixed. Defense cuts are having a significant impact. U.S. military aircraft sales, which long comprised the major share of U.S. aircraft manufacturing, declined after reaching a record of \$44 billion in 1987. Military aircraft sales dropped to \$35 billion in 1992. Boeing sells 20 percent of its products, by value, and McDonnell Douglas sells 60 percent of its products, to the U.S. Government, almost all of it to the Department of Defense (DoD) and the National Aeronautics and Space Administration (NASA). Exports are crucial to both companies. Boeing exports 55 percent of its aircraft and McDonnell Douglas exports approximately 25 percent of its products. Therefore, the significant reductions in DoD and foreign government military aircraft procurements as well as the global recession have affected the two U.S. aircraft manufacturers.

In the past, business on the commercial side has compensated for the cuts in defense. However, the conflict in the Persian Gulf and the world economic downturn starting in 1991 have had a devastating effect on airline traffic, producing the first downturn in airline traffic in the industry's history. While deregulation has fostered increased price competition among airlines, the economic downturn and slowdown in traffic has reduced or even eliminated profit margins in the short-term for many carriers, with some managements declaring bankruptcy. This combination of events has led to restructuring policies by airlines, a slowdown in aircraft orders and order deferrals. Worldwide, aircraft manufacturers have had to cut production rates of most models and are often facing unsold or "white tail" aircraft produced without a firm customer. These disruptions are undercutting efforts of the manufacturers to adjust to the defense cuts by transferring employees from defense to commercial product lines. At this time, both segments of the industry are in a recession.

Long-term Prospects for the Large Transport Aircraft Industry

In contrast with the current situation, long-term forecasts are optimistic for growth in aircraft sales. Demand in world commercial markets, particularly the expanding economies of Asia and the Pacific Rim is expected to show dramatic increases over the next 10-15 years. In fact, the larger share of the commercial transport market is now overseas, while the United States, as a percentage of the world market, will shrink. Airline traffic, especially international traffic, is expected to show strong growth throughout the rest of the decade and the industry expects to deliver over 14,000 aircraft over the next twenty years. That is twice the number of aircraft delivered over the past twenty years. Many new commercial sales are expected to come from the replacement of older, less fuel-efficient aircraft that will not meet airlines' requirements or federal and international noise and emissions standards.

Widebody, long-range aircraft, those targeted for the fast growing international markets, will experience tremendous growth. Industry forecasts predict annual deliveries of about 280 long-range aircraft in 2010, compared with only 100 per year in 1992. In this product segment, the U.S.-made aircraft, the Boeing 747 and the Douglas MD-11, are competing against the Airbus aircraft, the A-340, which just began being delivered and is Airbus' first entrant into the long-range market. Deliveries of short and medium range aircraft are also expected to increase.

Because of the future market potential, the two U.S. companies are actively investing in the development of new aircraft. Boeing is beginning production of its latest model, the 777, which is scheduled to enter service in 1995, and has teamed up with the major European aircraft manufacturers to study the feasibility of developing and building a jumbo jet aircraft, which would seat 600-800 passengers. These European companies also are evaluating the feasibility of a jumbo jet program separately through the Airbus consortium.

Most independent industry analysts agree that a market exists for an aircraft larger than the current B-747, but question whether more than one program can be produced at a profit. Regardless of whether a new jumbo jet is developed by U.S. manufacturers, by Airbus, or by an international consortium/joint venture, policy discussions will be required to review the effects such a large aircraft would have on the nation's transport system. The question of foreign government involvement is crucial in determining the competitive terms and conditions in the jumbo jet sector of the marketplace.

McDonnell Douglas is seeking equity partners for its future programs including the MD-12 program, an aircraft proposed to be larger than the current Boeing 747. McDonnell Douglas has stated that forming international and domestic joint ventures to develop such aircraft is the trend for the future. The costs and risks of programs to develop new transport aircraft or engines may well be too high for one company to finance on its own. Multinational cooperation also opens markets that might otherwise be closed, and can allow for mutual technology sharing.

Success in the largest transport segment of the aircraft industry has not come easily. Boeing admits that it "bet the company" on the development of the B-747. The gamble has been worthwhile. While U.S. aircraft manufacturers hold 68 percent of the total backlog for transport aircraft, they hold about 82 percent of the estimated value of the backlog for long-range aircraft, 54 percent for medium-range aircraft, and 65 percent for short-range aircraft. If successful, new technology long-range aircraft like the Boeing 777 and MD-12 could allow U.S. manufacturers to continue to lead in this segment of the industry. However, they will face strong competition from Airbus which has up to now benefited from massive government supports.

AIRBUS INDUSTRIE

Airbus Industrie represents the main challenge to the U.S. large civil aircraft industry. Airbus Industrie, the consortium responsible for coordinating development, production and sales, combines four European aircraft companies—France's Aerospatiale, Germany's Deutsche Airbus, U.K.'s British Aerospace, and Spain's CASA. It has proven to be one of Europe's most expensive as well be technically successful collaborative projects.

A 1990 study prepared for the Department of Commerce by Gellman Research Associates estimated \$25.9 billion in government supports, including accrued interest, has been provided by the Airbus partner governments—the Federal Republic of Germany, France, Great Britain, and Spain—to the development and production of Airbus aircraft. There is little likelihood that Airbus member companies will ever repay more than a fraction of these government funds. These supports have enabled the Airbus Consortium to develop and introduce a family of transport aircraft, to avoid

commercial risks, and to become the number two company in the global industry behind Boeing. Foreign government support of their aircraft industries also can exert downward pressure on the price of U.S. aircraft. This impact cuts more deeply into U.S. market share and makes it more difficult for U.S. companies to earn a profit and to reinvest in improved products.

The U.S./EC bilateral Aircraft Agreement puts constraints on the level of government supports for future aircraft programs. However, Airbus will face the need for new capital, as it launches new aircraft models. For example, the A350, a proposed 600-700 seat aircraft which would compete directly with Boeing's 747, is expected to require major funding in excess of \$10 billion. Airbus Industrie partner companies have not generated enough retained earnings to support new programs from internal sources.

We expect Airbus Industrie to survive. Our strong desire is for Airbus to compete on commercial and technical terms and not rely on government subsidies which continue to undermine U.S. industry and distort international competition. If this is accomplished, we foresee a positive future for the entire large commercial aircraft industry. The U.S. Government is ready to take appropriate action to ensure that Airbus competes on a fair and open basis.

INTERNATIONAL NEGOTIATIONS

On July 17, 1992, the U.S. Government and the European Commission signed a bilateral Agreement which disciplines government supports provided to the large civil aircraft sector. Specifically, the Agreement prohibits all production supports and places set limits on the level of permissible government funding for new aircraft programs. The U.S. Government and U.S. industry view the Agreement as a first step towards the progressive reduction of direct government subsidies to Airbus Industrie. Multilateral negotiations, which are focusing on broadening the product and country coverage of the bilateral agreement, have begun and are expected to continue through 1993 and possibly beyond. As part of these negotiations, the United States is seeking to strengthen the disciplines contained in the bilateral Agreement by further reducing the level of government support allowed on new aircraft programs and adopting a stronger dispute settlement mechanism. The U.S. Government and the European Commission are also holding consultations to monitor and enforce each Party's adherence to the bilateral Agreement.

The U.S. Government initiated the negotiations that resulted in the 1979 GATT Agreement on Trade in Civil Aircraft during the Tokyo Round. This Agreement was designed to discourage governments from subsidizing civil aircraft, but proved ineffective in halting subsidies, such as those provided to Airbus. Since 1985, the U.S. Government has engaged in extended negotiation with the European Commission to resolve this issue.

SUPPLIERS TO THE LARGE TRANSPORT AIRCRAFT INDUSTRY

U.S. suppliers to the large commercial aircraft industry are facing the same challenges faced by the U.S. large aircraft manufacturers. U.S. manufacturers of aircraft engines, engine parts, and aircraft parts shipped an estimated \$39 billion of products, and employed 284,000 workers, in 1992. This is down from \$50 billion and employment of 300,000 in 1991. The supplier sector continues to shrink and an additional major drop in employment is anticipated. In some ways, these changes are the result of improved technology and reliability, rather than simply a response to softened market conditions. The major engine manufacturers, Pratt & Whitney (P&W) and General Electric (GE), have announced workforce reductions. P&W is cutting its 1991 workforce of 44,000 down to 30,000 while GE is reducing from 36,000 to 30,000. Similar reductions are expected throughout the supplier sector. Despite the reduced demand, the U.S. engine segment is maintaining its global market position in the face of difficult foreign competition. Engines tend to be purchased by airlines independently from the aircraft, thus engine manufacturers are not affected directly by the increased Airbus market share. The aircraft parts segment, however, is directly affected as Airbus prefers to source from European suppliers.

Defense cuts have led many military-oriented suppliers to diversify out of the defense market. The Air Force Association, in its report called "Lifeline Adrift," indicated that between 1982 and 1987 about 15,000 suppliers left the aerospace defense market. More have left the defense market since 1987 and many of the remaining firms are contemplating mergers.

The commercial market for aircraft parts also has seen a reduction in suppliers, driven not by sales volume, but by the demand for greater efficiency. During the 1980s, while Boeing and McDonnell Douglas production was increasing dramatically, their supplier base fell from over 11,000 to below 4,000. Boeing and McDon-

nell Douglas have concentrated their purchases with a smaller number of high quality suppliers. In doing so, the manufacturers have reduced the cost and increased the quality of their aircraft. For parts suppliers, this streamlining has meant that only the most efficient and highest quality manufacturers have been able to stay in this market.

Aircraft parts suppliers also face the challenge of further globalization of large transport aircraft. Boeing and McDonnell Douglas have gradually increased the foreign content of their aircraft. For instance, ITA estimates that the percentage of foreign products (excluding the engines) installed on the Boeing 727, launched in 1959, was approximately 2 percent. Foreign products (excluding the engines) installed on the 767, launched in 1978, probably represent closer to 15 percent, and on the 777, launched in 1990, it may be almost 30 percent. For McDonnell Douglas, foreign products (excluding the engines) range from 15 to 20 percent of the aircraft value on the MD-11 and MD-80/90, up significantly from the content on the older DC-9 and DC-10.

The U.S. manufacturers have increased their purchasing from foreign suppliers for several reasons. The first is to increase their access to foreign markets. The use of offset arrangements, where customers make their aircraft purchase contingent on offset manufacturing or servicing concessions, is very common in the military aircraft sector. Until recently, almost all airlines outside the United States were at least partially government-owned. Governments have, in some cases, insisted that their airlines demand that local companies get contracts for spare parts or original equipment on the aircraft they buy. Second, foreign content also provides the manufacturers with access to foreign investment, launching a new large civil aircraft can cost a manufacturer \$4 to \$8 billion dollars, and can involve developing very risky new technologies. Finally, foreign content provides the manufacturers with access to low-cost labor. Seeking more efficient producers of certain products can help U.S. companies remain competitive.

The access issue can work both ways, however. U.S. companies do sell products to Airbus, and some have even become risk-sharing partners on certain Airbus models. U.S. products such as avionics, engine nacelles, and wing components fly on most Airbus aircraft. In response to the growing globalization of the aircraft market, U.S. suppliers have learned to work with as well as sell to manufacturers here and overseas. A marketplace free from government-imposed restraints is the key to getting the most efficient suppliers on everyone's aircraft.

U.S. GOVERNMENT POLICY

The U.S. Government can support the aircraft and aircraft suppliers' industries by ensuring a domestic environment favorable to the international competitiveness of all U.S. industries. The U.S. Government should also press for improved rules in government supports to ensure that foreign companies are not relying on government subsidies which undermine U.S. industry and distort international competition.

The U.S. Government must invest in generic, basic research that increases the competitiveness of all U.S. companies. The Administration's defense conversion initiatives are focusing future government research on areas which have commercial rather than defense possibilities. Government-funded basic research in a range of scientific fields (including aeronautics) will help U.S. aerospace companies compete.

The U.S. Department of Commerce, through our Technology Administration (TA), continues to promote effective commercialization of new technologies. The National Institute of Standards and Technology (NIST), TA's largest component, is playing a leading role in the President's technology reinvestment project, which is an integral part of the overall defense conversion initiative. The program is designed to stimulate new thinking in private industry, create partnerships between high tech corporations and government labs, and facilitate the transfer of technical expertise to the civilian economy. NIST is also sponsoring a number of in-house programs that are designed to improve U.S. competitiveness by helping spur technology innovation. One example is the Advanced Technology Program or ATP. ATP's goal is to assist U.S. businesses in carrying out R&D on pre competitive, generic technologies. ATP is an industry-led program - industry must provide at least 50 percent of the funding, and all applications are reviewed for their broad commercial benefits for the country as well as their technical merit.

The International Trade Administration, or ITA, of Commerce is helping the U.S. aircraft industry improve its competitiveness and reduce its reliance on military contracts through technical assistance and by helping them enter new markets here and abroad. On April 14, Secretary Brown met with the CEOs from the major aerospace companies and the trade association to discuss the key issues facing the aero-

space industry. ITA recently also has sponsored numerous trade missions to such parts of the world as Russia, South America, and Europe to increase our industry's competitiveness in the global market.

STATE OF THE U.S. AIRLINE INDUSTRY

The existence of a healthy, profitable U.S. airline industry is critical for the U.S. aircraft industry to maintain its market leadership. The current weak financial position of the U.S. airlines directly affects the short-term viability of the U.S. aircraft manufacturers by resulting in the cancellation or postponement of orders and by diminishing the all important domestic market base. The airlines have suffered from weak U.S. economic growth following on the heels of the Persian Gulf War, when air traffic declined precipitously. U.S. airlines lost a record \$3.9 billion in 1990 and an additional \$1.9 billion in 1991. Losses for 1992 are more than \$4 billion. This issue and the problems facing aircraft manufacturers will both be addressed by the "National Commission to Ensure a Strong Competitive Airline Industry", which will be sworn in next week. Because the state of the U.S. airline industry is so inextricably linked to the state of the U.S. aircraft industry, we look to the findings and recommendations of this Commission.

AERONAUTICAL TECHNOLOGY CONSORTIUM ACT OF 1993

S. 419, the "Aeronautical Technology Consortium Act of 1993", would establish an Aeronautical Technology Program to coordinate and redirect Federal aeronautical research and development programs to provide financial assistance to an industry-led consortium of U.S. commercial aircraft manufacturing companies, the Aeronautical Technology Consortium ("Aerotech"). The consortium, presumably modeled on SEMATECH, would focus on research, development and commercialization of aeronautical technologies, as well as the transfer and conversion of aeronautical technologies developed for military purposes to applications for commercial aircraft.

The legislation has the commendable objective of defense conversion and the translation of government-funded technologies into commercially viable products. It also positively fosters a partnership with industry which would focus on research and technological development. However, after reviewing this legislation, the Department of Commerce has identified certain concerns with aspects of the bill.

First, while it is true that increased efforts can be made to improve the coordination among the Federal agencies involved in aeronautical research and technology development, many of the activities proposed in S. 419 are already being conducted by NASA, DoD, the Federal Aviation Administration (FAA) or other agencies. In addition, the Office of Science and Technology Policy (OSTP) is considering ways to further improve interagency coordination. NASA, for example, is already working closely with the U.S. aircraft and engine manufacturing companies on basic and generic applied research projects to help develop the technologies required to make a high-speed civil transport commercially viable. This program involves a cost-sharing program with U.S. industry. In addition, this Administration's budget includes increased funding for civil aeronautics research and technology. Specifically, a \$1 billion budget request for aeronautical research and development has been proposed by NASA for FY 1994 to bolster the U.S. aircraft industry. This program would focus on expanding high-speed and subsonic research directly related to civil aviation and upgrading the national wind tunnel facilities.

Second, the legislation uses the model for the SEMATECH consortium for the aircraft industry. The unique characteristics of the aircraft industry may not apply to this model. Aircraft often require over a decade of research and technology development before a product is brought to market, unlike semiconductor products which generally require a much shorter time period. The five-year timeframe which is called for in the legislation is not long enough to allow most aircraft products to be successfully brought to market.

Third, the aircraft industry is becoming more and more global in nature and some U.S. aircraft manufacturers are entering into strategic alliances with Japanese and European companies. The bill's restrictive language regarding non-U.S. companies could limit the formation of these strategic partnerships which could limit international sales for U.S. companies.

While the Department of Commerce strongly supports the intent of S. 419 to assist the U.S. aircraft industry in meeting the current market challenges, we believe that there are certain aspects of the legislation which need further clarification. We look forward to working with the Committee on these issues.

Senator EXON. Mr. Hauser, thank you very much. I believe you are next, Mr. Goldin.

**STATEMENT OF DANIEL S. GOLDIN, ADMINISTRATOR,
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

Mr. GOLDIN. Thank you, Mr. Chairman.

I would like to say that we in the United States are fortunate enough to have been given a wake up call. This wake up call says that our aeronautics business is on the edge. We did not hear that wake up call a few decades ago with a number of other industries. The American aerospace industry is one of the largest manufacturing sectors in America, and the second largest exporter with a positive balance of trade: \$28 billion a year, second only to agriculture.

I say we sit on the edge for a number of reasons. First, in 1969, we owned 91 percent of the long-haul jet air transport business and, as we heard, we are down to 67 percent and dropping.

Senator McCain talked about the general aviation industry, and we have gone from 18,000, I believe, to 656, was the last number I heard, sir, and still dropping. We do not build very many commuter aircraft—I think just a few. Newly developed countries are building more aircraft than we are. At the high end of the market, we are being pressed. At the low end of the market we are being pressed. And as a Nation, 20 years ago we set the level of the playing field, and today we are slogging it out with everybody looking at 5- and 10-percent performance improvements.

We need a drastic change in the approach to our aviation industry, and it is more than to support just the aircraft and engine manufacturers. The whole infrastructure must be looked at. The number of airports are limited. In the United States, 90 percent of the passengers fly to 100 airports in 65 cities. Forty-three percent of the fixed-based operators in America are losing money.

When an airport closes and becomes a shopping center or parking lot, it is irreversible. General aviation is as important as subsonic transport and commuter aircraft, and we have to look at the whole context. We have to look at the command and control and positioning. We have to look at the modern cockpit and the safety and the emissions. It is a broad-ranging program, and it is crucial.

It is the National Aeronautics and Space Administration, and for too many years, it has been small a, big S. We have taken a very hard look at the aeronautics industry and, as administrator, I have personally spent 3 months of my time meeting with the chief executives of the major aircraft manufacturers, the general aviation industry, traveling the country, and I see a story that is very, very, very serious. We are having a silent death of our technology infrastructure.

When you see a bridge rotting or you see a road rotting, it is visible to the American public. But I want to tell you, our third-tier suppliers, the machine shop operators, I met with them in Hartford, CT. They told me they have 6 months to 1 year to stay in business, because they do not have the integrated flywheel or the broad range of products that they used to make.

When we take a look at leapfrog technologies and look at new combusters for supersonic aircraft, we cannot even buy the basic materials for those combusters in the United States. We have to go overseas. So, we are talking about a broad issue, a broad range of issues from system design, to safety, to emissions, to suppliers, to engineering.

Toward this end, NASA has proposed a very major program for this year in our fiscal year 1994 budget submission. Even though our budget is being cut by \$15 billion over the next 5 years, we are proposing a 55-percent increase in our support to the commercial aeronautics industry of the United States of America. We think this is crucial.

It is a four-point program, and this program was not developed by NASA, it was developed by going to the industry and saying: What are the critical technologies—not developments, not subsidies, not tooling, not support for building production—but what are the critical technologies that you need over the next 30 years?

Toward that end, we developed a four-point program. No. 1 priority: high-speed civil transport. The possibility for this market is 500 to 1,000 planes at roughly \$200 million a plane and 140,000 jobs. If we were to solve three basic problems: first, developing a jet engine that does not damage the ozone layer by controlling the oxides and nitrogen; second, controlling the noise on takeoff; and, third, building a plane that is economical, so that it does not belong to the elite, does not have a high premium price, and will allow 500 to 1,000 planes to be sold.

The second priority: long-haul subsonic transport and general aviation. We will work to make these planes much more fuel efficient and much quieter. Many countries around the world are imposing new noise standards. It could prevent American manufacturers from selling their products in overseas markets unless we resolve the emissions and the noise problems. And, most importantly, we cannot continue to make 2- and 3-percent improvements to our aircraft. We have to set new standards and take on critical, high risk, leapfrog technologies that will allow the American manufacturers not to worry about subsidies, because they will be so superior, the product will stand for itself.

The third priority that we have is our infrastructure. It is rotting. Our wind tunnels are 40 years old. They are unproductive. They do not have the proper capabilities. America must have a resurgence in our wind tunnel capability. We are working in cooperation with the DOD, the FAA, and the Department of Transportation so that America will have centers of excellence in wind tunnels and other critical facilities for computational and other support activities for the industry.

In our budget, we have proposed \$200 million as a starter to get the planning done and the preliminary design done. But I want to say that this is going to be a multibillion dollar activity. It grieves me—I cry when I have to think about Boeing and McDonnell-Douglas testing in France, the Netherlands, and Russia because we do not have productive wind tunnels in this country. And here we are having critical technology that we are giving away to the rest of the world.

So, that is our third priority.

The fourth priority is we cannot just focus on the next 10 to 15 years. We have to look 30 years out. So, in cooperation with the Department of Defense, we are looking at hypersonic flight and we are looking at a plane that will take off from a runway and go to space, fly mach 23, and come back down, an aerospace plane. America was ready to test a scramjet engine in 1969 on the X-15,

when we had the boldness to do risky things. We did not test that scramjet engine. There are 12 countries in this world working on scramjets, and newly developed nations are flying scramjets before America.

We cannot walk away from this technology. We must move forward. And we must have a commitment that we are going to have a program that looks out 30 years, not a quarter, not a fiscal year, not a Presidential term, but 30 years, and we look forward to cooperating with this committee on getting America back to where it was, being bold and not being afraid to take risk.

And I leave you with this thought: When I met with the industry and the National Research Council and members of universities, I asked them ought what we to do. They were a group of people who said, let us work on safe things, because if we work on risky things we may fail. This is the problem we face in this country. So, I propose that we move forward and do bold things and not be afraid, and take on the rest of the world, because we have what it takes in America.

Thank you very much.

[The prepared statement of Mr. Goldin follows:]

PREPARED STATEMENT OF DANIEL S. GOLDIN

Mr. Chairman and Members of the Committee, it is my pleasure to be here today to discuss a subject of great interest, the competitiveness of our country's aviation industry. I would like to discuss the general situation facing the aviation industry, explain how we have structured NASA's FY 1994 Aeronautics Program to meet that industry's changing needs, and comment briefly on S. 419, the Aeronautical Technology Consortium Act of 1993. We look forward to working closely with the Committee to ensure that NASA's Aeronautics Program is successful in meeting national needs.

Mr. Chairman, the message we want to leave with you today is that NASA and this Administration are deeply committed to strengthening aviation in this country, and we believe our strategy will accomplish that. Our objective is to improve U.S. competitiveness in civil aviation and enhance the safety and capacity of our National Aviation System by developing and commercializing high-payoff technologies. Because our work is done for industry or other agencies, we especially appreciate the value of our close working relationships with these partners. We understand well the importance of accountability, both to our partners and to the American taxpayers who foot the bill for our research programs. I want to assure you that NASA's aeronautics program is being managed to emphasize accountability and results.

As global competition increases, we will have to improve our ability to assist industry to commercialize technology. We are all painfully aware that Airbus beat us to the punch in commercializing, among other advanced technologies, fly-by-wire controls, a technology invented in the United States by NASA and DoD. To prevent this kind of occurrence in the future, we are now working harder at developing and validating new technologies for industry to commercialize, and we intend to do it faster, better, and cheaper than our competitors. NASA's Aeronautics Program can contribute by ensuring that commercialization by industry is an integral part of program planning from the very beginning, accomplished in cooperation with our partners. This is a change from the way we have done business in recent years—a much needed change—and exactly the tack we are taking.

Those of us in this room desire to improve competitiveness not just for its own sake, but because aviation is one of this country's most successful industries, largely thanks to a long history of Government-industry cooperation and innovative contributions from the university research community. We all know that over the past couple of decades, the world has changed in several significant ways, and our investment strategy—both in dollars and the way we manage them—must change to keep up. In addition, airlines have been deregulated, the Cold War is over, and the aeronautics industry has gone global. We must keep all of these factors in mind as we refocus and reinvigorate our national program of aeronautics technology research and development, in which NASA is an essential player.

As you are well aware, the U.S. aviation industry is huge. Aircraft manufacturers recorded over \$95 billion in sales in 1992, contributing \$28 billion to our balance of trade and employing one million people in high quality jobs. Long-range prospects for growth are very good: industry experts calculate that the global civil transport aircraft market will be worth more than \$500 billion through 2005, approaching \$1 trillion through 2015.

That's the good news. The bad news is that as the market grows, the U.S. is losing its share. In 1969, our market share was 91 percent. Today, it is 67 percent and falling. Airbus already holds 30 percent. Japan and Taiwan are attempting to enter this lucrative market, and even Russia may be able to compete for a share if it teams with another nation. While our aircraft manufacturers are hurting, the U.S. airlines are also facing grave difficulties; although the airlines generated substantial revenues of \$75 billion in 1991, they still lost money.

The airlines' predicament highlights the fact that competition from foreign manufacturers is not the only challenge facing our aviation industry. We must improve the efficiency of our national aviation system, upgrade safety, and resolve environmental concerns as well. Advanced technology is a critical element of our response to all of these challenges. And NASA's role is to develop this technology. Clearly we must reverse the decline of U.S. aviation—now—by providing our industry the support it needs to remain a world leader.

Much of that support will come from NASA. I would like to turn now to the specifics of NASA's Aeronautics Program and its impact on industry's competitiveness. In FY 1994, our request for aeronautics is up 18 percent over FY 1993 funding. We will use this increase primarily to expand our civil aviation programs in three key areas: high speed research, subsonic research, and national facilities. There continues to be discussion in the aeronautics community over priorities; should subsonic or high speed research be our first priority? Our answer is that this is a false choice. We need to invest appropriately in both. Our program is, and must remain, carefully balanced to ensure the health of the aviation industry in the near-, mid-, and long term. In addition to our expanded activities in civil aviation, we continue our commitment to a crucial technology program with future civil and military applications, the National Aero-Space Plane. The final piece of our program is an expanded High Performance Computing and Communications Program which will speed development of the National Information Infrastructure. I will briefly go through each of these important areas.

HIGH SPEED RESEARCH

NASA's High Speed Research (HSR) program is leading the development of the highest risk technology that will allow industry to build an economical, environmentally friendly commercial aircraft that industry studies indicate will fly at two and a half times the speed of sound, carrying 390 passengers over 5000 nautical miles. The studies indicate a potential market of 315,000 passengers per day in 2000, increasing to 600,000 in 2020. This translates into 500-1000 High Speed Civil Transports (HSCT). This would be a big boost for the U.S. economy, if we are the ones who build it.

The main problem we need to solve before this kind of aircraft is feasible is pollution: air and noise pollution. Many of you may remember the Supersonic Transport program of the 1970s—the SST. It was canceled in part because of environmental concerns; high speed transport engines can emit ozone-depleting nitrogen oxides (NO_x) into the upper atmosphere and generate unacceptable levels of community noise, and the effects of the aircraft's sonic boom on people and animals are worrisome. Having learned our lesson with the SST, this time around we are addressing these crucial environmental concerns up front. Simply put, if this aircraft harms the environment, it cannot be built. To understand better the potential atmospheric effects, we are working in close coordination with NASA's Office of Mission to Planet Earth, the international scientific community, the FAA, the Environmental Protection Agency, the United Nations Environment Program, and the International Civil Aviation Organization. These studies will eventually lead to environmental certification requirements for future high speed transports. On noise, our goal is to enable industry to build engines that will meet FAR 36 Stage 3 requirements the most stringent noise standards which currently apply to subsonic aircraft. This will mean that high speed transports can take off and land at any airport currently used by subsonic aircraft. Our Phase I environmental studies give us confidence that the emissions and community noise concerns can be adequately addressed; we are working closely with U.S. engine manufacturers to develop technology for cleaner, quieter engines and the results are quite promising. Regarding the sonic boom, although studies indicate this aircraft will be economically viable without flying

supersonically over land, we are working on ways to soften the sonic boom to ensure minimal or no harmful effect on human and animal life from its operation.

While we continue working with industry to solve the environmental issues, in FY 1994 we plan to begin Phase II of the HSR program, which is aimed at developing the highest risk technologies that will help make this aircraft economically competitive with subsonic aircraft, and therefore profitable for industry to build and operate. In collaboration with industry and universities, we will develop and validate critical portions of new technologies such as advanced propulsion, new materials, improved aerodynamics, and cutting-edge flight deck systems. The FY 1994 budget request for the High Speed Research program is \$187.2 million.

I'd like to emphasize our close cooperation with industry on the HSR program. While NASA will concentrate its investments in the early, high-risk stages of research and development, our partners in industry are planning to make a substantial investment in this program as well. We are working together to define technology priorities, and are sharing investment and risk. Companies are coming together as teams to meet the tremendous challenges of this program, rather than going it alone. For instance, a team of companies and universities is working on enabling propulsion materials. To meet anticipated environmental requirements, a future HSCT's engines must burn at very high temperatures; new ceramic matrix composite materials to withstand temperatures up to 3000 degrees fahrenheit must be developed. We are encouraging this team approach and anticipate that as the HSR program progresses many more teams will develop to meet other challenges. If funding and schedules remain steady, a U.S.-built High Speed Civil Transport aircraft could be certified by 2005, guaranteeing once again the preeminence of U.S. industry in the world aircraft market.

SUBSONIC RESEARCH

While HSCTs promise to be the wave of the future in long-distance air travel, subsonic aircraft will continue to handle the dominant portion of passenger traffic even after new high speed transports are flying. For that reason we are aggressively augmenting the Advanced Subsonic Technology program, an initiative begun in FY 1992, as well as our other work in subsonics. We are requesting \$101.3 million for advanced subsonic technology which is focused specifically on giving back the competitive edge to U.S. companies by developing technologies that will increase aircraft efficiency, improve safety, and reduce development costs. Let me share just one example. Last year, in partnership with the FAA, we successfully flight-tested in Orlando and Denver three types of sensors for wind shear detection and avoidance. Results indicate that these sensors can provide up to 40 seconds of warning to a pilot, enough time to avoid the dangerous wind shear condition and possible disaster. When this kind of equipment is put on aircraft, U.S. companies will have a technological advantage in the marketplace.

The Advanced Subsonic Technology program encompasses nine major technology areas: fly-by-light/power-by-wire, aging aircraft, composites, technology integration and environmental impact, noise reduction, propulsion, short-haul, terminal area productivity, and integrated wing. I'd like to specifically call out our new emphasis on both fixed and rotary wing short-haul aircraft technology. I have directed a task force of the Aeronautics Advisory Committee (AAC) to look specifically at fixed-wing short-haul aircraft, which should report this summer. On rotary wing (tiltrotor) aircraft, NASA is continuing to work with FAA on a technology development program to address critical issues for civilian tiltrotors. By the end of the summer, the AAC task force and NASA researchers will develop a comprehensive NA5A/industry/university research and development action plan, for implementation beginning in FY 1994, to help revitalize the important short-haul aviation industry segment. The objectives are to: 1) increase the national air space system capacity by expanding the role of fixed-wing and rotary short-haul aircraft through higher utilization of the air space and the large network of general aviation public-use airports; and 2) develop and apply technology to improve the safety and expand the utility of U.S.-produced short-haul aircraft. Key elements that technology must address are: improved safety, environmental compatibility, advanced user-friendly cockpits, advanced controls, performance efficiency, and lower initial and operating costs. This focused short-haul effort, together with new developments in the other high-payoff subsonic technology areas mentioned above, will make possible a safe, highly productive global air transportation system that includes a new generation of environmentally compatible, economical aircraft that are superior to foreign products.

I mentioned our partnership with the FAA on wind shear research earlier. Under a Memorandum of Understanding signed in 1990, we are working closely with the FAA in a number of areas of mutual interest. In FY 1994, we intend to expand our

work on integrating cockpit and air traffic controls, enhancing safety by reducing human error, and reducing aircraft noise and emissions. We are continuing to work on improving safety in severe weather and predicting fatigue-crack formation and operating lifetimes for aging aircraft. For inspecting hard-to-reach aircraft parts, we are looking into advanced infrared, thermographic, ultrasonic, optical, and magnetic techniques. In addition, we are jointly evaluating a four-dimensional air traffic management system, developed at NASA, that will improve air traffic control, enabling more on-time arrivals and cutting aircraft fuel consumption. The FAA is currently testing this technology at the Dallas-Fort Worth and Denver airports. All of these programs contribute to aviation safety and the competitiveness of U.S. industry.

AERONAUTICS FACILITIES

Let me turn now to our national facilities. One way we can ensure that the U.S. aviation industry remains the best in the world is to maintain the best, most productive aeronautics research and testing facilities in the world. Our customers have told us that our facilities, especially our wind tunnels, are the single most important service NASA provides. However, our facilities are aging, and many were designed as research, rather than production, tunnels, and are therefore of limited use to industry in developing new aircraft. Newer European facilities, including subsonic wind tunnels in England, France, and the Netherlands and a new transonic wind tunnel to come on line next year in Germany, offer higher quality test conditions and productivity. To keep U.S. companies and their technology at home, we must upgrade the Nation's aeronautical testing capability. Our FY 1994 budget reflects this commitment, with \$200 million for upgrades and planning of new facilities. I would like to mention two facilities that preliminary results from our National Facility Study indicate may be needed: a high Reynolds number subsonic tunnel and a high Reynolds number transonic tunnel. These facilities would be production tunnels, rather than research tunnels, meaning industry would be able to test large pieces of equipment at near-flight conditions and get a lot of data in a relatively short turnaround time. We also intend to invest in productivity upgrades to existing facilities and will continue studying future facility needs in partnership with industry and other government agencies. To help enable funding, deactivation of some existing unproductive facilities is also being investigated. The bottom line is that this Administration is committed to providing industry with the world's best testing capability.

DUAL-USE TECHNOLOGIES

In addition to our strong commitment to civil aviation in this country, NASA's Aeronautics Program also encompasses important dual-use technology efforts, which are carried out for the Department of Defense or cooperatively with them. We will continue to develop and validate high priority dual-use technology that will improve the performance of future military aircraft while also benefiting the commercial aircraft industry.

Our largest cooperative program with DoD is the National Aero-Space Plane (NASP) program, which is dedicated to developing and demonstrating the enabling technologies for future operational hypersonic aircraft. Hypersonic vehicles may be the means of routine, efficient and responsive access to space for civil and/or military missions we are looking for. In the future, technologies developed by the NASP program may provide our industry with the capability to "leap-frog" the competition and develop an entirely new generation of aerospace vehicles. In addition, much of the research is applicable to aircraft operating in lower speed regimes and even to other industries. For instance, industry already has commercialized materials processing and computational methods developed under this program. We are strongly committed to continuing this beyond-the-state-of-the-art technology program, and with DoD and our team of five major industry partners are restructuring the program so it is affordable, realistic, and reduces technical risk. NASA's request for NASP in FY 1994 is \$80 million.

HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS

The last program area I will briefly touch on is High Performance Computing and Communications. NASA is a major participant in this interagency program. In the field of aeronautics, highperformance computing will enable us to enhance industrial productivity and competitiveness by improving aircraft designs, compressing the design process, and cutting certification costs. We plan to invest our FY 1994 funding (\$65.6 million) to speed development of our National Information Infrastructure, a Presidential initiative led by the Office of Science and Technology Policy.

This work will benefit not only our industry, but will make major contributions to educating our future technical workforce as well.

UNIVERSITY RESEARCH

This leads me to our investment in college education and university research. NASA's Aeronautics Program issues grants for specialized university research centers, student training (e.g., fellowships), and university investigators engaged in aeronautics research. In light of changing national needs, we are updating our university grants strategy to ensure that we encourage invention and innovation in the university research community and provide developing engineers with the skills, knowledge, and incentive they will need to be creative and productive in the workplace of the future.

S. 419

As you can see, Mr. Chairman, NASA has an aggressive program in aeronautics which is closely tied to industry, universities, and other government agencies. We believe that pursuing this program, in close cooperation with our partners, will do much to strengthen the U.S. aviation industry. It is our opinion that these activities strongly support the basic intent of S. 419, the Aeronautical Technology Consortium Act of 1993. NASA is sending a letter to the Committee detailing the Agency's position on S. 419. In brief, the Administration recommends delaying action until the National Commission to Ensure a Strong Competitive Airline Industry has reported; we believe that the Commission will address many of the concerns raised in the proposed legislation. In addition, pending the findings from the Commission, the Office of Science and Technology Policy (OSTP) plans to create an interagency mechanism within its existing mandate to address many of the key issues raised in S. 419. NASA and the Administration share with the Committee a recognition of the difficulties facing the industry, and support the objectives of S. 419. We are committed both to doing more to support the aviation industry and doing it better by fostering closer coordination of federal efforts. We believe NASA's Aeronautics Program, in the context of a comprehensive Federal effort coordinated by OSTP, will accomplish many of the bill's objectives; already NASA's industry, university and government partnerships are gaining momentum in that direction.

CONCLUSION

In conclusion, I would like to quote the Wall Street Journal of March 8, 1993, which stated: "The U.S. is the world leader in aircraft production and airline services." President Clinton and NASA intend to keep it that way, working closely with the Congress and U.S. industry to ensure that our program is properly focused on real national needs. Implementing a more aggressive and augmented NASA Aeronautics Program will not be easy, but it certainly is within our grasp. We need you to help by holding us accountable for every penny of taxpayer money we receive; this effort is too important to the Nation to tolerate anything but the most effective stewardship of scarce resources. We expect that good planning, strategic investments, and hard work—by us and our government, university, and industry partners—will pay off in a stronger, more competitive aviation industry. We look forward to working with the Committee to ensure that it does.

Thank you, Mr. Chairman. I will be happy to answer any questions you or other Members of the Committee may have.

Senator EXON [presiding]. Mr. Goldin, thank you very much.

Mr. Hauser and Dr. Perry, thank you for being here this morning. I first want to apologize to the panel for not being here earlier. I have been chairing an Armed Services Committee hearing for the last hour and a half on more mundane matters. No cameras, no press, open hearing, all that we are talking about is launching the greatest, biggest spending program—\$400 billion—to clean up the environment from our nuclear experiment.

It is the single biggest expenditure of taxpayers' dollars in history. And no one cares. It is nice to be over here where the cameras are and where the action is. That does not mean to take away a moment from your excellent testimony.

I am pleased to see that on Monday next we are going to have finally the swearing in at the White House of the commission that

has been created to address this matter. Your testimony has been particularly helpful this morning. The Commerce Committee is tackling this issue. And I was reminded, Mr. Hauser, that there was a time when we excelled far and above any other country in the world in two areas—agriculture and airplanes and space technology. We only have agriculture left, and I think it is critical that we do something about this.

Thank you for your testimony.

We will begin the questioning now.

Senator Danforth.

Senator DANFORTH. I want to thank each one of you for your testimony. I really do not want to ask specific questions about the Aerotech bill, because if I were to do that, we could get bogged down in the details very, very quickly. But I want to simply make sure that I understand what you were saying.

I think all of you are saying that this industry, the U.S. aircraft manufacturing industry, is and must continue to be a critical industry in this country. And I think each of you is saying that this is an industry that right now has some very serious problems, and that we must address those problems with a sense of urgency. Maybe I am putting words in your mouth, but do you agree with that? Have I stated a proposition which all of you can agree with?

Dr. PERRY. I agree with that.

Mr. HAUSER. Yes.

Mr. GOLDIN. I agree completely.

Senator DANFORTH. Now, you have also stated your desire to work with Congress. Can I ask you, generally speaking, again, without asking about the details or launching into a flyspecking of the legislation, do each of you think that something like the Aerotech legislation, something like it, should be enacted into law?

Dr. PERRY. Senator Danforth, I believe that.

Mr. HAUSER. I would agree, Senator.

Mr. GOLDIN. I agree also. I think that when we do look at the Aerotech legislation we should take a look at it in the total context of what we want to do with the American aircraft industry. And if we look at it as a synergistic activity, I think it will enhance what we are trying to do. And I come back to my point that we are not just looking at manufacturing, we are not just looking at jet engines, we are not just looking at airframes, but we have to take a look at the total aeronautics infrastructure.

And let me give you one of the examples that I think about. We will not be able to see a significant increase in the number of airports worldwide. One of the things that is crucial that we look at is how can we safely land more planes at the existing airports that we have. That involves a broad range of system engineering, and goes even beyond what an airframe manufacturer could look at. It gets into the type of things that the DOD and NASA and the FAA have been working with over the years, but it needs to be more focused.

So, the concern that I have is, before we go get this Aerotech—and I agree with Dr. Perry—that if it focuses with industry-led manufacturing activities, it could be very helpful. But we must set the context of a very broad-ranging program. And I think this is the crucial element.

Senator DANFORTH. On the other hand, we could deal with, broadly speaking, the problems of life. And then begin to narrow it down, you know, and in a process of decades, we could maybe address the question of what sort of legislation we would get to.

I guess the point that I want to get to in this question is, if we do have an urgent situation, and if something like Aerotech would be helpful. Let me say, as the author of the legislation, I do not care if my name is on the bill or if it has this bill number, whoever wants to introduce it, fine. But I would hope that even before this commission completes its work, the process of working on whatever we are going to do with respect to something like Aerotech can go forward and that we as a committee could avail ourselves of the offer that I think I heard from each one of you to cooperate with the committee in putting something together.

Mr. GOLDIN. Let me say I agree with that. The point I was trying to make is if we take a look at the wonderful things we have done in the defense world in Apollo and some of the other national programs we have had, it comes from a broad-thinking system engineering. And I think we can move out with Aerotech. I did not mean to say we should not do it. But the message I was trying to make is I think there are incredible capabilities in a number of Government agencies, and we ought to do that, but let us not stop there.

Let us take a look at how America, which has probably the best system engineering skills in the world, looks at the broad context of this program. I do not think we need thousands of people working decades to solve this problem.

Senator DANFORTH. I understand. And I think Senator McCain's opening statement I thought was excellent, because he talked about the whole breadth of issues that is involved, and there is a breadth of issues. But if something like Aerotech is any meaningful part of what the answer is, my only plea is that we work even now, even as before the commission is sworn in, maybe using what is in this legislation as a model. And if we want to scrap it and move onto something else, fine.

But I don't want to just wait until August and then say, "All right, now we have got a report." Now the next step is to study the report, which is the typical way we do things.

I would like to just ask Dr. Perry one question, because my time is running out. On Aerotech, there is a role for Government—financial support of Aerotech. Is it your view that this would require new money, or is it your view that this could be done within the context of the present DOD budget?

Dr. PERRY. First of all, Senator Danforth, I would repeat the point that I made in my statement, that there ought to be Governmentwide support for this program, including the DOD. Second, if it is at the level of SEMATECH, where the Government's contribution was \$100 million per year and the DOD would be a part of that \$100 million, I would believe that it could be done within the existing funding.

Senator DANFORTH. OK. Thank you.

And with respect to NASA, Mr. Goldin, could it be done within the context of NASA today?

Mr. GOLDIN. Yes, sir.

Senator DANFORTH. Thank you.

Thank you, Mr. Chairman.

Senator EXON. Thank you, Senator Danforth.

Senator McCain.

Senator MCCAIN. Thank you, Mr. Chairman.

Dr. Perry, in your opening statement you said that you believe that some of the lessons learned in SEMATECH would apply here in assisting in addressing the issue of competitiveness in the aerospace industry. Could you elaborate on that and what we might have learned and what could be translated into the kind of action we would like to see taken?

Dr. PERRY. Yes. The first and most important lesson is the essential ingredient of industry leadership. SEMATECH actually took the lead. Industry actually took the lead in forming SEMATECH and came to the Government with a proposal. I would like to see the aerospace industry take a similar lead here; that is, put the proposal together and come to the Government and ask—with their program—for assistance. I just believe that industry leadership is essential.

I think it is likely we will get it. But I would like to see for sure. My only serious reservation on this legislation is that I have not seen industry step up to that leadership yet.

Second, I thought SEMATECH floundered the first few years looking for a specific program to pursue. They were considering the development of products. They concluded, as I think correctly, that that was a mistake. And instead, they ought to put their major focus on developing and manufacturing process technology, manufacturing standards. It would be useful to the whole industry.

I believe that same concept would apply to aerospace as well. Not only would these standards and process technology apply to the airplane manufacturers, but they would apply to the component suppliers as well. And so it would be a benefit to the whole industry if that were to be done.

It would stand in some way comparable to the support that NASA provides the industry in terms of the infrastructure such as wind tunnels. That is something the entire industry can draw on. And in the case of manufacturing process technology, that is something the whole industry could draw on, the whole industry could benefit from.

Those would be my primary lessons.

Senator MCCAIN. And I think those are very important ones.

Dr. PERRY. The last one obviously was the costsharing—50/50 costsharing, I think, was from the beginning embedded in SEMATECH. And I think that is a crucial concept here as well, not just because you leveraged the money.

You get more money out of it, but most importantly, it guarantees industry's real attention to this program.

Senator MCCAIN. It certainly does focus it; does it not? Why is it, Dr. Perry, that industry has not stepped forward yet to take the lead, in your view?

Dr. PERRY. I should say that a number of companies are considering this. And I am sure some are ready to step forward. The industry, as a whole, has not banded together. I think it is because

the industry is so diverse as compared with the semiconductor industry; they are very different industries in this respect.

It is particularly important to find a program, an R&D program or agenda, that will satisfy the interest of all of them. And it is particularly important that we not focus on products, which tends to separate the companies rather than bring them together.

Senator MCCAIN. And what would your view or vision of DOD's involvement, if you are modeling this kind of organization along the lines of SEMATECH?

Dr. PERRY. It could provide a very similar role to what it provides in SEMATECH. Except I think that it should provide it in conjunction with other government agencies—NASA and Commerce being two obvious examples.

Because, while the Department of Defense plays a crucial role in that we are one of the largest suppliers of R&D for the underlying technology for the aerospace industry, if this is to be successful, it has to have a very sharp focus on what is going to be useful for the civil industry.

Senator MCCAIN. Thank you, Dr. Perry.

Mr. Hauser, you heard Mr. Goldin's comments about the light aircraft industry or small aircraft industry in America. Do you have any views on the issue and how we might try to address what has been basically the demise of a very important part of America's economy, which has obviously, as I stated in my opening statement, far more or far-reaching consequences ranging from employment to supply of pilots to the airlines?

Mr. HAUSER. I would second what the administrator said, Senator. Obviously, my testimony focused primarily on the large commercial aircraft segment of the industry. We are equally concerned with the segment you referred to. We have made it a focus of various of our efforts on the trade promotion side.

Again, I reference Secretary Brown's efforts. In the Middle East we had some interest in terms of some of the smaller aircraft producers in there. We weigh in very frequently on their behalf in international competitions.

But I think the thrust of this bill, as my colleagues on the panel and as a number of the Senators have stated, should encompass that segment of the industry as well, because it is such a broadly diverse industry.

Senator MCCAIN. Do you believe that product liability reform would be a critical element in resuscitating the industry?

Mr. HAUSER. It is an item that is on the administration's agenda. Certainly, Senator.

Senator MCCAIN. In what respect?

Mr. HAUSER. I am not an expert on that aspect of what we are doing. But again, having been involved in some testimony with Secretary Brown before, it is an issue where the excessive limits of liability are inhibiting to that particular sector of the economy.

I know the administration is studying carefully what kind of improvements could be undertaken.

Senator MCCAIN. Thank you.

Thank you, Mr. Chairman. My time has expired.

Senator EXON. Thank you for your remarks, Senator McCain.

Senator Gorton.

Senator GORTON. Thank you very much. I think, Mr. Goldin, it was you who made the statement in explicit terms, but each of the others did in more general terms, that we need to look not at a 6-month perspective or a 2-year perspective or the perspective of a single administration, but forward 15 years in the field in which we are dealing.

As I say, I am sure that that is a sentiment that each of the others shares. I wonder if any of you have any suggestions as to how we attempt to institutionalize the long run when all of us have careers of necessity which are relatively short run; one administration, one term, the next election or the like.

This is not of course a problem which is unique to the aerospace industry but to many things that we do here. But is there some way in the aerospace industry, is it some form of this Aerotech in which we get out of this next election or next administration than reinvesting the wheel kind of situation and allow a more thoughtful and authoritative planning over that 15-year span?

Mr. GOLDIN. I would like to take a cut at that. I think that, as a Nation, we have to forget about career spans and we have to forget about what is on my watch and what did I accomplish? This is the problem we have.

And when you take a look at aviation and you take a look at the leadtime for technology, it is not going to encompass one administration. And therefore, I think the crucial factor is a relationship with the industry that binds the government, just like when we made an international relationship. It subtends administrations.

And just think about nuclear test ban treaties or other such treaties. I would view it in the same level as we made a treaty with another country. We ought to make a treaty and commitment with our industry. Because if we do not do it and if we continue to work in quarters in 1- and 4-year increments, we are not going to be the world leaders that we were.

And again, I want to go back to the past and say, we had an X program in this country. We went faster and more economical and better for year after year after year with planes. And we were not sure exactly how it was going to be used.

I want to tell you, out of the X-15 program came the materials technology that helped the steel industry with roller bearings. But we did not have to write a whole bunch of proposals and make justifications for why the X-15 was going to help the steel industry with roller bearings.

So, what we have to start doing is taking on risky, difficult things and not be afraid to break down barriers and look upon this just as we looked upon treaties. It is a simplistic view, but America has got to change. We cannot go for a quarter, 1 year, and 4 years.

Senator GORTON. Do either of the other of you want to comment? Thank you for that answer. Do any of the other of you have anything to add?

Dr. PERRY. I would comment on that. Very important fiscal decisions can focus on the long term; if we look at the issue we are discussing today, they are decisions as to how much to spend for our technology base in this program. It is the 6.1, 6.2 so-called programs.

As our defense budget goes down, as our procurement budget goes down, there is a temptation to bring that technology base budget down with it, which I think would be a great mistake.

In fact, over the last 7 or 8 years, our procurement budget for airplanes has gone down more than 50 percent. It has gone from \$37 billion down to about \$15 billion. That is a major drop in procurement, and it is obviously going to have a profound impact on this industry that we are talking about.

But we are maintaining the technology base essentially constant during that period. And that is planning for the future, that is looking out 5, 10, 15 years into the future.

It is difficult to do that. It is difficult to hold the line on the technology budget when everything else is coming down. But I think in response to the question that you raise about keeping our eye on the long term, that is what we have to do.

Mr. HAUSER. Senator, in one particular aspect of it, the trade dimension. I think we are beginning to take steps toward that kind of longer term vision.

I mentioned in my testimony we did conclude the Airbus agreement with the European Community last year. We view that as a first step in a process, Senator, not the end step in a process. We know that we need to expand the coverage of that agreement. So, we have entered into multilateral negotiations as new actors come on board in the international aviation arena, to bring them under the scope of the agreement.

We know that the subsidy levels agreed to in that agreement need to be progressively reduced over time and will be engaged in bilateral and multilateral negotiations aimed at doing that. So, at least on the trade front, this aspect of it we are trying to put a long term time horizon on it.

Mr. GOLDIN. I would like to agree with what Dr. Perry said and just add maybe a little twist to it. The R&D expenditure in the Government and in industry has been dropping. And maybe one of the things we might think about is, I think it is crucial that the DOD maintain the R&D budget at a stable basis, even though production is coming down.

But we ought to be talking to the industry and come up with some costsharing basis—and I think it again subtends Aerotech, but we should not stop and say we should not do Aerotech—to see how we could work with industry and get this kind of long-term arrangement I was talking about on a percentage of share to maintain stability in the R&D budget.

And I do agree with Dr. Perry that that is the right place to start working it.

Senator GORTON. Thank you. Thank you, Mr. Chairman.

Senator EXON. Thank you very much, Senator.

Gentlemen, as we talk about the future of aviation or aerospace technology and all of these things that we would like to regain our leadership in, I would like to ask you about something that I think all three of you have probably some feelings about.

I am focusing on to probably provide, if correctly handled, some renewed American leadership with almost unlimited potential for spinoff for jobs and research and development in future technology. I refer, of course, to our global positioning system.

Dr. Goldin, you stressed the need for upgraded facilities and systems and I believe that a space-based air traffic control system using GPS is one way to bring in safety and efficiency and even capacity to the aviation industry in America, probably worldwide.

I think we need to make critical decisions about the future management of GPS, probably starting today and hopefully this system then could help us regain the leadership that we so desperately need.

I think maybe a space-based air traffic control system for the next century, expanded upon what we have now, would be absolutely vital if we want some new innovative thoughts in this particular area. Lots of things are being considered today and I would like to have as briefly as possible each member of the panel address these three questions.

Should GPS be civilianized? If not, why not? Two, should user fees, royalties or other forms of costsharing be contemplated as a part of this expanded system; and three, if GPS is moved out of DOD—and I am not saying it should be, but if it is moved out of DOD—what management system would you think might stand in its place?

Any of you start, whoever feels most comfortable.

Dr. PERRY. I will make a few comments on that, Senator Exon. My own judgment is that GPS should be a dual-use technology. Obviously inherently it is dual use, but I think it ought to be managed that way as well.

I believe that it has substantial application in the civil area and that we ought to organize the system so that we get the full benefit of that application.

It also has, as we learned in Desert Storm, very substantial applications in the military field. The one reservation that I would have about the use in the civil area is that if we were unhappily propelled into a major war, we would want to find a way of keeping the benefits of GPS from any adversary we had in the war.

I do not believe that is inconsistent with the full use of GPS in the civil sector during peacetime operation.

Mr. HAUSER. Senator, I would defer to my colleagues from DOD and NASA on this one.

Senator EXON. Mr. Goldin.

Mr. GOLDIN. With regard to the first question, I think it would be very difficult to just say, let us take GPS away from the DOD. I believe that there is a dual-use approach. I concur with what Dr. Perry said.

With regards to user fees, there is a concern that I have and this gets back to a competitiveness issue. And the question is, should there be a user fee for non-U.S. companies using the system? And that is a question that does provide me a bit of a problem.

I also would like to say that GPS is not the only issue that we have to look at at a system basis. I believe that communications systems for aircraft, as we have them, are not where they should be. And I think that there is an opportunity, either with a dual-use DOD communications system or a commercial communications system, that could give us real time, all-weather, higher reliability, high-quality communications to and from aircraft and to make that available not just to large aircraft where you could afford to spend

tens of thousands of dollars, but make it available to the general aviation fleet. This is crucial.

And the other leg I would add to the stool would be the weather information that could go to pilots, not just on a macroscopic level, but on a microscopic level. There is a whole series of cooperative programs going on on wind shear.

Which brings me back to the issue that I was talking about. There is more to the issue than just the GPS, the aircraft and the engines. There is a broad system engineering problem. And when we take a look at dual-use technologies, I think there is a lot of fruit to bear if we could get together and work with the DOD, the Department of Commerce, the Department of Transportation and the American communication satellite and space industry to take a look at how we build this broad infrastructure the aircraft.

So, again, I am sorry to broaden the issue, but I really think that this was very, very key and I think it answers the sense of the question that you asked.

Senator EXON. Thank you very much. I would certainly say that it seems like it is being used now a great deal. Even bus companies in some cities are using GPS at the present time to locate where a bus is running on a certain street, and it has unlimited potential and a whole series of command, control, and communications aspects.

I would certainly recognize that the Department of Defense paid for this program. I think that has to be our first goal. It seems to me like the scrambling of information in some fashion from that would be hopefully possible and necessary. That is our first line of defense with some system like that, and I do think, and I have heard about some activities going on between the different departments today, and I applaud that.

I think there is an unlimited potential here that we have only scratched the surface on, and maybe one new initiative that we should be working on, and with that I thank you very much.

Are there further questions of this panel?

Senator DANFORTH. I would just like to make one point, Mr. Chairman, not really apropos of this particular legislation, that Mr. Goldin was talking about his commendable efforts to find out what is going on in the aerospace industry and to talk to people who are in the industry, and that reminded me of a conversation I had some months ago with Dr. Perry.

I am really concerned about the perceived relationship of people between people who are trying to do business with the Federal Government and the Government itself. I think it would be worthwhile for people who are in Government to have some conversations with contractors and to ask, What is it like from your standpoint to do business with Uncle Sam?

One person I know who was in the defense contracting business, is now out of it, when asked why, why did you get out, told me I do not want to do business with anybody who thinks I am a crook and he does not want me to make a profit.

I know that where there are cost overruns, where there are allegations of fraud and so on, Government does not want to be victimized, but I also know that sometimes we can carry the accusatory role maybe a little too far—the whole business of the indirect costs

controversy with research universities really having its origin, I guess, with the Stanford problem, Dr. Perry.

But I know that research universities now are living in terror that thousands and thousands and thousands of transactions are going to be reviewed to see if there is some mistake somewhere in them, and that is going to lead to the mortification of the university.

I do not want to indicate that I think we should go soft on malefactors, but I really think that when we are talking about the future of research and when we are talking about the future of high-technology industries doing business in the United States where Government is going to play a role in one way or another, we should maybe try to find out if we have gone too far in Government.

I know that Vice President Gore has talked about reinventing Government, the President has, and making it more user friendly and so on, but I would think a part of that is to adopt some sort of rule of reason in dealing with people who are trying to do business with us. That is just a comment.

Mr. GOLDIN. I would like to respond and say I am very sensitive and I believe all of us in Government are sensitive. The research universities have some very significant problems. I spent my career in industry. I have only been in Government for 1 year.

I believe that in aerospace, space, and aeronautics, if we do not have a good business relationship with industry we have a serious problem. When we had a very robust defense program and when we had a very robust space program we could afford to go to industry and get our unique products.

As we transition into the postcold war era we are going to have a much higher reliance upon commercial products from industry. If we have an adversarial relationship with the industry, I do not know how we are going to get the products we need to do our jobs, so I think there needs to be things done on both sides.

But most importantly I think we in Government have to develop a set process for contracting that gives incentive to the contractors to bid to perform and not bid to win. I think that is the single biggest problem that we have. Again, we do not have bad people, but the system has driven us to a point where the contractors are put into a very difficult position.

Our systems are not set up to motivate performance. At least, I will speak for NASA. We in NASA are trying to change that, and I hope that that will back us off from this adversarial relationship, because our industry—again, I say they have wonderful people, but we have a system that is now antiquated and we must change the system because the world is changing, and so you are right on.

Senator DANFORTH. Thank you.

Senator EXON. Gentlemen, thank you very much. You have been very helpful. We appreciate your coming here this morning, and thank you once again.

The second panel I will call at this time includes Mr. John Wolf, executive vice president of Douglas Aircraft, Mr. Mike Hudson, director of engineering for Allison Gas Turbines, and Timothy Pettee, vice president, Alliance Capital Management Corp.

Gentlemen, we welcome you, and unless there is some other arrangement among the three of you, we will start out with the testimony of Mr. John Wolf. I would say that any written statements that you have submitted to the committee we thank you for, and they are made a part of the record at this time.

We will start with Mr. Wolf. Welcome, and we would appreciate your summarizing your testimony at this time.

**STATEMENT OF JOHN WOLF, EXECUTIVE VICE PRESIDENT,
DOUGLAS AIRCRAFT CO.**

Mr. WOLF. Thank you. Mr. Chairman, thank you. I have prepared a statement which I will submit for inclusion in the record and with your permission will briefly summarize it for the committee.

Our industry is confronted with numerous problems and challenges, the most obvious being the simultaneous effects of a virtual collapse of our defense market as a result of the end of the cold war and the worst downturn on record in the commercial aviation industry.

In this environment, it is not surprising that industry employment is declining. McDonnell-Douglas Corp. has been more aggressive than others in implementing the dramatic, albeit painful, cost-saving measures necessary to survive these difficult times.

The good news is that these measures are paying off for McDonnell-Douglas. We have recently reported record earnings for our first quarter of 1993, and Douglas reported its 10th consecutive quarter of profitability.

At Douglas, we have made great strides in improving our efficiency and are able to remain profitable with commercial aircraft production rates even lower than we are utilizing today. Our backlog of commercial aircraft orders is more than sufficient to keep Douglas healthy through the slump and beyond. Despite what has been stated in previous hearings and in the media, Douglas will survive this downturn, as it has survived previous periodic downturns in the last four decades.

Our recommendations in keeping our airframe industry competitive fall into four categories: first, revitalizing the health of the airline industry; second, opening avenues for financing; third, encouraging industry competitiveness; and fourth, revitalizing the aerospace industry.

Let me briefly highlight some specific proposals. Revitalizing the health of the airline industry is absolutely essential to McDonnell-Douglas. Our recommendations include relief from the alternative minimum tax, increased funding for aviation infrastructure, and FAA R&D efforts in safety and air transit productivity.

Another important step is opening new avenues of finance, which is essential not only for new international markets but also for domestic markets. The Export-Import Bank is a valuable asset in expanding overseas opportunities despite its chronic shortage of staff and resources. I would like to make one suggestion concerning the Eximbank. I would argue that it needs to provide more flexible financing for potential overseas customers. While Eximbank must critically assess the credit risk of each customer, it should not be risk-adverse.

In addition, McDonnell-Douglas would urge Congress to look at the possibility of starting a new loan guarantee program, and "domestic Eximbank" which would provide an avenue of financing for U.S. airlines desiring to replace older stage 2 aircraft with new stage 3 aircraft on a 2-for-1 replacement.

Also, both Congress and the administration must be sensitive on how actions taken in Washington encourage or discourage industry competitiveness. For example, the continuation of China's unconditional most-favored-nation trading status is of paramount concern to McDonnell-Douglas. The industry forecasts predict that over the next 20 years China will require \$40 billion in new commercial aircraft.

We urge the committee to support initiatives which specifically revitalize the aerospace industry. The expanded aeronautics program that was amended by NASA in late 1992 with substantial industry input has found strong support in the Clinton administration. If the \$8.6 billion multiyear program is funded, the supersonic and subsonic technology activities and the new wind tunnel facilities should benefit our commercial aircraft products in the late 1990's.

Finally, McDonnell-Douglas supports S. 419, the Aeronautical Technology Consortium Act of 1993, as a constructive first step in improving the competitiveness of our industry. The concept of a coordinated national aeronautics technology strategy is welcomed, especially if it helps focus the resources currently spread across the various agencies. We also support the concept of a Government coordinating committee and the industry advisory committee.

With regard to the consortium proposed in the legislation, let me say the SEMATECH model may need to be significantly modified for our industry. We do believe that productive partnerships could be enabled by the legislation if the threat of antitrust action could be minimized.

Given the emphasis on subsonic and supersonic aeronautical technology in the NASA program the real value-added of S. 419 is the focus on manufacturing technologies. The development of currently available and newly developed manufacturing methods to reduce production span times and total cost by 15 to 30 percent would have a significant impact on competitiveness. Moreover, the impact could be realized in 2 to 3 years.

Mr. Chairman, the problems facing both the airline and aircraft manufacturing industry are affecting our ability to compete in today's marketplace. I hope that for initiatives such as S. 419, where there is a central consensus between the executive branch, Congress, and industry, we move as expeditiously as possible rather than delay action pending completion of work by the Presidential Commission. Losing ground in our industry today will make the task far more formidable tomorrow.

Thank you, Mr. Chairman. That concludes my remarks. I would be happy to respond to your questions.

[The prepared statement of Mr. Wolf follows:]

PREPARED STATEMENT OF JOHN WOLF

Mr. Chairman, I am John Wolf, Executive Vice President of the Douglas Aircraft Company in Long Beach, California. I am pleased to appear before your committee today to discuss issues which are of critical importance to the commercial aircraft

industry and McDonnell Douglas. McDonnell Douglas appreciates the Committee's efforts in pursuing ways of maintaining the preeminence of the U.S. commercial aircraft industry. The Congress and the Administration must help promote an atmosphere that will enable our nation to continue to enjoy its hard-earned lead in aerospace technology and as a source of high-skilled and high-paid jobs.

Aerospace has the largest positive trade balance of any U.S. manufacturing sector. In 1992, the aerospace industry, as a whole, recorded a \$31.4 billion trade surplus while employing one million workers. U.S. Sales of large civil transport aircraft in 1992 totaled \$28.8 billion. But employment is declining and the industry is confronted with numerous problems and challenges. Our customers world-wide have also been severely affected by the global economic slowdown. As a result, most airlines have experienced record losses resulting in the outright cancellation and/or deferral of orders for aircraft. As the airlines must take actions to ensure their survival, so must we.

In response to the depressed state of the commercial aircraft industry, MDC has not been alone in its implementation of dramatic, albeit painful, cost-saving measures. We were simply the first. Having worked through numerous industry downturns in the past and drawing on more than four decades of continuous commercial production experience, we acted early to offset the adverse impact of the worldwide recession on our industry.

Yet, we must still respond to our customers future requirements with efficient aircraft which will earn them profits. We also must be able to earn sufficient profits so we can continue to invest in new aircraft design and manufacturing technologies which satisfy both the airlines' and our own cost concerns.

The commercial aircraft industry and the airline industry are inexorably linked. A healthy U.S. airline industry would certainly bolster our profitability, with corresponding effects on U.S. jobs, investment, and balance of trade.

The Administration and Congress are considering a wide array of potential programs and policies with the intent to strengthen our industry and to preserve high-skilled and high-paid jobs. In so doing, it is important to keep in mind that the airline and aircraft industries need appropriate short-term incentives with which to rebuild a firm infrastructure for the future. We have grouped our recommendations into categories:

RESTORE THE HEALTH OF THE U.S. AIRLINE INDUSTRY

There are a number of measures that would be beneficial in enhancing the competitiveness of both the civil aircraft and the airline industries:

1. the amelioration of the Alternative Minimum Tax (AMT) on capital intensive industries such as the U.S. airline industry. The AMT's negative impact is especially pronounced during recessionary times because corporate profits are low while capital expenses may continue to be high. Congress should support the President's proposal to reform the capital cost recovery provisions of the corporate AMT;
2. increased government funding for airports, runways, and air traffic control systems;
3. increased government funding for research projects related to the safety and productivity of the U.S. air transportation system;
4. containment and rationalization of health care costs;
5. reform of products liability law so as to set national standards, establish reasonable statutes of limitations, and contain unreasonable damage awards (and related insurance costs); and
6. reform antitrust law to place greater emphasis on international competition and globalization.

OPEN AVENUES FOR FINANCING

The Export-Import Bank

Another area where government action would enhance our competitiveness is expanded support for the Export-Import Bank (Eximbank). Eximbank is the U.S. Government agency responsible for facilitating the export financing of U.S. goods and services by either funding or guaranteeing the funding of a portion of the export. To date, even with limited staff and budget, Eximbank has done a fine job of assisting aerospace exports. In the near-term, immediate help from Eximbank is required to get through the current depressed airline cycle. In the long-term, future global trading will be significantly more competitive and the willingness of Eximbank to take greater risks as a counter to Airbus is required. The U.S. Government's assistance in this area will be more critical than ever.

Eximbank's ability to provide support is limited by an annual budget, which has been capped at \$15.5 billion for Fiscal Year 1993. In addition, the amount of support

Eximbank can commit annually is limited by a calculation which determines the cost of the support. For Fiscal Year 1993, this amount is \$757 million. Eximbank's support of commercial aircraft is also limited by the Large Aircraft Sector Understanding (LASU), which imposes disciplines on the use of official export credits in the large civil aircraft sector.

In addition, Eximbank has established an Aircraft Matrix which is more restrictive than the LASU and further restricts its financial support based primarily on the credit of the user airline. European export credit agencies operate without any Matrix restrictions. The airframe and engine manufacturers have been working with Eximbank to find ways to make the matrix more flexible. Some progress has been made, but more progress is needed.

Eximbank continues to operate under a tight budget. Existing staff does a commendable job with the limited resources available. However, they appear to operate in a manner that places more importance on the assurance of repayment than on facilitating exports. The equation that balances U.S. employment with repayment risk is what needs to be solved to be more competitive with our European competition. Further, we recommend that Eximbank's fiscal year loan guarantee cap should be increased to a minimum of \$20 billion and the subsidy element be increased to at least \$1 billion.

Eximbank's primary focus should be to facilitate U.S. exports and thereby sustain U.S. employment. In its difficult task of balancing U.S. exports against credit risks, Eximbank should place somewhat greater emphasis on U.S. exports. Since aerospace products represent our nation's number one merchandise export, Eximbank should establish a dedicated aerospace division with significantly greater resources and staff. Lastly, although they must abide by LASU, Eximbank should be more flexible with regard to the Aircraft Matrix.

The Aviation Revitalization Act of 1993

The nation's largest passenger and cargo airlines support "The Aviation Revitalization Act of 1993" which will be introduced in the very near future. It is designed to enable carriers to secure federal loan guarantees to either acquire or lease new Stage 3 aircraft in exchange for using the government loan guarantees, the passenger carriers would be required to retire Stage 2 aircraft at an accelerated rate. On the other hand, the cargo carriers could modify the Stage 2 aircraft to Stage 3 standards and not be required to retire them.

As a general matter, we support the legislation. We believe that the legislation would benefit U.S. airlines and be helpful to U.S. manufacturers. It appears that U.S. carriers will be better able to exercise options and reserves for aircraft currently on order. However, we are concerned that the bill does not adequately account for the longer economic life of Douglas Aircraft products and may strongly encourage their premature retirement of aircraft from the U.S. domestic fleet which otherwise could be modernized cost-effectively.

ENCOURAGE INDUSTRY COMPETITIVENESS

The U.S. commercial aircraft industry requires policies which foster competitiveness and unencumbered access to markets world-wide. The reconciliation of economic and foreign policy is essential for not only our industry, but for overall competitiveness of American products. All too often foreign policy trade controls have been used in such a manner that our own industries are denied access to foreign markets while our foreign competition can operate without restraint. We should not penalize our own economic interests, particularly when our foreign policy objectives will be undermined by a lack of broad based support.

The problems posed by unilateral economic sanctions and export controls are profound. Foreign competitors are undoubtedly mystified and delighted by the U.S. tendency for unilaterally denying its businesses the opportunity to sell commercial products, such as commercial aircraft to the targets of U.S. foreign policy displeasure. At a time of large trade deficits and fierce international competition, U.S. policy makers need to confront the reality that we can ill afford the luxury of such economically harmful policy tools.

China MFN

For example, the continuation of China's unconditional Most Favored Nation (MFN) trading status is of paramount concern to McDonnell Douglas and the American business community. China has been a bright spot for McDonnell Douglas and the U.S. commercial aircraft industry. China's economy is booming. China's economic reforms have resulted in strong economic growth, which has spawned unprecedented demand for commercial aircraft while airlines around the world have been canceling orders. Industry forecasts indicate that over the next twenty years, China

will require \$40 billion in new commercial aircraft. U.S. manufacturers currently enjoy a 76 percent market share in the PRC market. In 1992, the U.S. aerospace industry recorded a \$2.1 billion trade surplus with China and generated over 40,000 U.S. jobs. Terminating MFN, or even making it conditional, could seriously hurt the U.S. economy and decrease aerospace employment while handing over this huge market to our eager foreign competitors.

Airbus

There is another critical challenge confronting the U.S. civil aircraft industry. For many years, our industry had gone unchallenged as the predominant supplier of large commercial aircraft to the world's airlines. Yet, in a relatively short period of time, we have witnessed the emergence of a significant competitor, Airbus, which now threatens the very fabric of the U.S. aerospace industry.

Airbus' ability to take virtually unlimited risks without concern for a public balance sheet has greatly contributed to the erosion of U.S. market share and profits of the U.S. industry. The massive subsidies have isolated Airbus from the normal commercial pressures of pricing, inventory, cash flow, and return on investment, to name but a few. The loss of thousands of jobs at Douglas Aircraft alone, can be attributed to the subsidized seizure of market share from U.S. industry.

The U.S. Government is engaged in the process of multilateralizing last year's aircraft agreement between the U.S. and European Community to include other major aircraft-producing nations of the world. Such countries include Japan, Canada, and Brazil. The objective of this process is to establish firm multilateral disciplines on subsidies in the civil aircraft sector, and to ensure that the ability of countries to compete in the highly competitive field of commercial aircraft development, production and sales is based on industry's technological creativity and a level playing field. Whether these lofty goals can be realized remains to be seen.

As you know, the highly respected Department of Commerce-sponsored 1990 "Gellman" study makes the clear and convincing case that Airbus has been the beneficiary of more than \$26 billion worth of trade-distorting government assistance since its creation in 1968. Airbus continues to receive massive government support even though it has a world-wide market share in excess of 30 percent. This \$26 billion figure does not even include the indirect aid it has received through the defense departments of the four member countries—France, Germany, the United Kingdom, and Spain. Our European critics argue that the U.S. commercial aircraft industry received huge financial support from defense programs. This argument is a red herring that has gone belly up.

The U.S. industry continues to work very closely with the Office of the United States Trade Representative in crafting a multilateral version of last year's agreement which would, among other things, include improved disciplines and transparency. We support the multilateralization effort. We look forward to working with you and your staff on this very contentious and complex issue.

REVITALIZE THE AEROSPACE INDUSTRY

R&D Tax Credit

Continued technological achievement is dependent upon large investments in research and development and capital equipment. The President has proposed a permanent extension of the R&D credit but on an incremental basis without adjustment for current circumstances. Few aerospace companies will receive an incentive under an incremental credit system even if they make significant new investments, because they will first need to replace the investments attributable to their shrinking defense business that are included in the base periods. The Research and Development Act of 1993 introduced by Senators Danforth and Baucus is a welcomed solution to this problem. The legislation alleviates part of the incremental problem for companies which have invested in the defense business and provides some incentives for investing in the commercial sector. We support this legislation.

Aeronautics Technology Consortium Act (S. 419)

McDonnell Douglas supports (S. 419) as a constructive first step in improving the competitiveness of our industry.

The concept of a coordinated national aeronautics technology strategy is welcomed, especially if it helps focus the resources currently spread across the various agencies. We also support the concept of the Government Coordinating Committee and the Industry Advisory Committee.

We caution, however, that the legislation should not inhibit the implementation of the existing NASA Aeronautics Technology Program, which has been developed with substantial industry involvement. We recommend that NASA's programs should be managed as planned rather than via any newly formed consortium. Of

course, these initiatives and the benefits derived from them, would be conducted within the limits set forth in the US-EC Civil Aircraft Agreement signed in July 1992.

Given the emphasis on subsonic and supersonic aeronautical technology in the NASA program, the real "value added" of S. 419 is the focus on manufacturing technologies. The deployment of currently available and newly developed manufacturing methods to reduce production span times and total costs by 15-30 percent, would have significant impact on competitiveness. For example, the application of high speed machining to reduce parts count and assembly costs, the introduction of low cost, light-weight composite structures, and the use of automated assembly techniques are all achievable in the near term, given adequate investment.

The Defense Transition legislation already passed and planned for future years is probably the best vehicle for government investment in manufacturing technology for our industry. If a national aeronautics strategy can help focus the implementation of the Defense Technology Conversion Program on large civil aircraft, then S. 419 will have achieved its purpose.

I would like to comment on the implementation of the program. The legislation aims at providing assistance to the formation of an aeronautical technology consortium modeled on Sematech. Although consortia or joint ventures may offer advantages in selected areas of technology, we are concerned that the Sematech model may need to be significantly modified for our industry. The wide range of critical design and manufacturing technologies, the large scale on which we operate, and the competitive nature of the industry will make it difficult to form a single consortium. We do believe that productive partnerships could be enabled by the legislation if the threat of anti-trust action could be minimized.

NASA Aeronautics Technology Program

The expanded aeronautics program that was announced by NASA in late 1992, with substantial industry input, has found strong support in the Clinton Administration. If the \$8.6 billion, multi-year program is funded, the supersonic and subsonic technology activities and the new wind tunnel facilities should benefit our commercial aircraft products in the late 1990's.

However, the aeronautics program should not be funded at the expense of space station. Our work in the civilian space arena is critical to our being competitive in many other facets of our business. Many companies in the aerospace industry are trying to diversify in an era of defense cutbacks. We are trying to capitalize on the highly skilled workforce that we have and utilize some of the core technologies. Commercial aviation and the space program are natural outlets to channel these technologies and skills. Invest in aeronautics, but don't renege on the nation's civilian space program.

The NASA program has three major elements:

- Advanced subsonic technology
- Aeronautical development facilities
- High speed research

The impact of each will be experienced in the order they are listed.

The subsonic technology program has been planned with active industry participation and will focus on aerodynamic design, propulsion, structures, materials, and flight control technologies, all of which have the potential of improving the competitiveness of the next generation of subsonic transports.

Similarly, the proposed improvements to existing wind tunnels and the two new tunnels under consideration, should significantly enhance future product development. The industry needs high productivity facilities that accurately simulate the flight conditions of modern aircraft to avoid costly full-scale flight tests and subsequent design changes to correct deficiencies. Current NASA and DoD facilities fall short on both counts of productivity and accurate simulation and the costs of new tunnels is beyond the reach of industry alone.

If a U.S. High Speed Civil Transport is to be developed to capture a lucrative market early in the next century, the NASA High Speed Research program must be supported. Several different market forecasts predict a need for 500-1,000 supersonic aircraft early in the next century, if the environmental, design, and manufacturing issues can be resolved. We have every reason to believe that appropriate investment will reduce the technical risk to the point that industry will be able to commit to the costly specific aircraft development program required, starting in the year 2000. However, the high risk nature of the enabling technology development makes it an appropriate candidate for NASA sponsorship prior to program go-ahead.

We believe the NASA Aeronautics Technology program to be well conceived, appropriately balanced and worthy of congressional support. We strongly recommend you pass the President's Aeronautics Budget as submitted for FY94.

SUMMARY

Currently, the commercial aircraft industry is suffering as a result of various economic factors. We need the U.S. Government to share the vision and the leadership to invest in technologies for the future. We, at Douglas Aircraft, are looking to the future. When the economy recovers, Douglas Aircraft has positioned itself through a series of painful steps to be a strong competitor in the anticipated future growth of air transportation. Global alliances will also play a key role in our future success. International partnerships will expand our market and production base, thus enhancing our employment base here in the United States. We have proven we can improve our performance. We look forward to the challenges and opportunities ahead.

U.S. policies must also look to the future and must take into account the critical importance of the civil aircraft industry to our nation's economy. The United States can ill-afford to lose its competitive advantage in aerospace. We want to ensure that the aerospace industrial base and the associated high-technology jobs are preserved. Actions taken today by Congress and the Administration will foster continued growth tomorrow.

If we have learned any lessons from the past, it is that it's more economical and prudent to maintain a world-wide position of leadership, than to attempt to regain it. Mr. Chairman, McDonnell Douglas appreciates the concern and the efforts your committee has taken on behalf of the industry at this very critical juncture in our history and we pledge our support for your efforts.

Senator DANFORTH. Thank you, Mr. Wolf. Mr. Hudson.

**STATEMENT OF MIKE HUDSON, DIRECTOR OF ENGINEERING,
ALLISON GAS TURBINES, ON BEHALF OF AEROSPACE INDUSTRIES ASSOCIATION**

Mr. HUDSON. Mr. Chairman, thank you for the opportunity to appear before you and your committee today to discuss the issues in the aerospace industry. While I am from Allison Gas Turbines, I represent the Aerospace Industries Association, AIA, which is the trade association that represents the Nation's manufacturers of commercial and military aircraft and related components.

To maintain a strong position in aeronautics will require not only a focus on technical superiority but also technical affordability. Today's financially hard-pressed airlines need competitively priced, easily maintained, efficient aircraft of the right size and configurations fundamental to their buying decisions where their new technology improves performance; that is, provides value to the customer in a real and measurable way.

A strong position in aeronautics also requires solving the technical problems that face the industry in the areas of noise, emission, and air traffic control.

AIA has been actively involved in these issues, and recently released a series of policy papers. I would like to submit them for the record. The AIA industry competitiveness enhancement initiatives prepared in April of 1982 and updated this last February, and a recent study of the industry, "The U.S. Civil Aviation Industry, Can It Retain Its Leadership?"

We must increase investments in commercially oriented aeronautical technology. Despite the enormous return the country has experienced from its investment in civil aeronautics technology, the share of NASA funding devoted to this important area of research and technology development has been insufficient in past years.

Our industry applauds NASA's proposed increase in aeronautics funding. We also hope to see systems technology with near-term competitive payoff receive increased emphasis within NASA. This proof of concept work that drives down the risk of applying new

technology for private companies, who in turn must invest heavily themselves, will develop models and major components such as engines.

Commercial success depends on improving technical achievements and reducing the critical time between technology development and its application in a product. Currently, AIA, in concert with its educational foundation, the National Center for Advanced Technologies, or NCAT, is working toward this goal by coordinating industry, Government, and academia's efforts in technology research and development.

NCAT has identified key or critical technologies needed for future maintenance of U.S. technology superiority and is currently working with NASA and DOD to facilitate technology DEMOS, demonstrations of engineering and manufacturing operations systems.

In the field of subsonic aircraft, it is estimated that aeronautical technology gaps are underfunded by \$1 billion per year. Fully funding the High Speed Civil Transport—HSCT—as long as those goals remain achievable, will keep the United States in the forefront of this area of high-potential aeronautical technology.

It is important, as work begins now, to allow certification of an aircraft in the 2005 to 2010 timeframe. Challenging technology hurdles to be faced include, first, making a system that is environmentally sound, and then achieving cost of competitiveness with the best subsonic jets today.

Looking at agency coordination potential, we see great synergy between civil and military technology development. This makes sense to the United States as we move in the direction of a single, flexible industrial base that supports both defense and civil market requirements.

The United States needs a coordinated approach to civil aeronautics technology development during this era of economic and political change. Relevant technology should be shared and supported by NASA, the Department of Defense, which has a highly disciplined and institutionalized process of technology development, and the Federal Aviation Administration and other agencies.

Industry must have a leading role in this process. There is too much at stake to allow artificial barriers that limit our technological progress. With teamwork, we can lead in terms of new technology solutions and technology affordability, we need to emphasize both if we are to maintain global dominance. Industry applauds your efforts, Senator Danforth, in highlighting the importance of the aircraft and aeronautics industry to the health of our economy.

Through the introduction of S. 419, the Aeronautical Technology Consortium Act of 1993, the debate on how the United States should remain competitive in this country's leading export area commenced. We have asked our members for their views on this approach.

In performing this review, the AIA member companies have divergent opinions on various provisions. In general, there is agreement on the need for a more coordinated approach among the Federal agencies. However, we are in general concerned that the SEMATECH-like model is inappropriate for the aerospace industry.

SEMATECH was established to pursue a single goal. The challenges facing the aviation industry in the United States are complex, and differ from one segment to another.

We are also concerned that the Aerotech model may be inconsistent with provisions of the U.S.-E.C. bilateral agreement covering subsidies to large aircraft and may exceed the limits of Government support that are established in this agreement. However, we do believe that the Government can provide a better business climate in which industry can reduce cost, pursue new markets, and increase the capability to compete internationally.

We believe Congress can focus its attention on the following regulatory and legislative impediments which, if removed, could provide industry with the ability to become more competitive. Let me address a range of factors that are driving up costs for American industry.

First, the cost of regulation. Federal regulations have played an important role in developing the demand for aviation products and services by building confidence in air travel, but regulation imposes cost also, and therefore affects the aircraft's price, marketability, and operating cost.

Our industry also believes that our civil aviation regulatory process has suffered from the lack of overall strategy. Regulations and airworthiness directives have increased without sufficient consideration or priorities of cost-benefit analyses.

We would like to see a regulatory action based upon an undeniable connection between accident prevention and regulation. A priority weighed regulatory strategy based on safety return per dollars spent would make our skies safer and our manufacturers more competitive.

I cannot leave the issue of regulation without mentioning environmental concerns. Our industry has for many years been pushing to develop technology to meet aircraft noise requirements and control pollutants. We have achieved a great deal, but not enough to meet the most stringent demands being imposed.

With respect to noise, we must seek solutions that balance the public's interest in quiet communities with the technical feasibility of achieving further reductions in aircraft noise and the ability of the airlines to afford these new, quiet aircraft. Communities must help find solutions through better land use planning.

For the emissions and manufacturing processes, let us set timetables that are reasonable in light of industry's dedicated search for solutions. We are pushing the boundaries of current engine technology now with respect to noise emissions.

In manufacturing and field support we are pressed in some instances to find substitute processes which do not yet exist, nor can we compromise safety. Let us instead set timetables that are achievable for environmental goals and are reasonable and consistent with technology capabilities.

Finally, current antitrust laws are unsuited to industries that are engaged in global production and markets, and facing strong foreign competition. This certainly is the case with the aircraft industry. We believe U.S. antitrust laws and policies should be amended to permit domestic cooperation through production and marketing of a product where there is effective foreign competition

and targeting of U.S. firms. We are pleased with the current efforts in Congress today addressing these areas.

The airlines are our customers, and what affects them affects us. The physical infrastructure itself works against reducing costs. We need new airports and runways to reduce delays. We need to remove limitations on air traffic controls systems and ATC procedures that lead to inefficient airspace and ground operation.

Relief from these problems is tied to an aggressive implementation of the Aviation System Capital Investment Plan and greater use of the Aviation Trust Fund moneys to pay for airport improvements.

In the face of government-supported competition, there is little sense in handicapping ourselves with unilateral export controls that reflect sometimes rapidly changing foreign policy agendas. Seldom do such controls accomplish their objective. At the same time, they disrupt aircraft buying and selling relationships that are typically long term.

In the civil aircraft industry, a sale lost through the lack of financing actually entails a stream of lost sales of the same or follow-on models of parts, spares, and services over a 15- to 30-year period. This is why the Export/Import Bank must have resources to support the industry against foreign competition.

The AIA appreciates the interest shown by your committee. Congress and the administration in looking for ways to support aviation in the United States. We stand ready to assist you at any time with these issues, and I would be pleased to answer questions at the appropriate time.

Thank you.

[The prepared statement of Mr. Hudson follows:]

PREPARED STATEMENT OF MIKE HUDSON

Thank you for the opportunity to appear before you and your committee today to discuss the status of the aerospace industry. I am Mike Hudson, director, engineering, Allison Gas Turbine representing the Aerospace Industries Association (AIA). AIA is the trade association representing the nation's manufacturers of commercial and military spacecraft, and related components.

Over the past decade, a consensus has developed that the U.S. must maintain its premier position in aeronautics. This view was echoed recently by the National Research Council of the National Academy of Sciences, by Administrator Goldin, who has spoken here today, and by the Clinton Administration.

To maintain a strong position in aeronautics it will require not only a focus on technical superiority, but also technology affordability. Today's financially hard-pressed airlines need competitively priced, easily-maintained, efficient aircraft in the right sizes and configurations. Fundamental to their buying decisions is whether new technology improves performance in a real and measurable way. A strong position in aeronautics also requires solving the technical problems that face the industry in the areas of noise, emissions and air traffic management.

AIA has been actively involved in these issues and recently released policy papers on these issues. I would like to submit for the record the AIA Industry Competitiveness Enhancement Initiatives, prepared in April 1992, and updated in February, and a recent study of the industry, The U.S. Civil Aircraft Industry, Can It Retain Leadership?.

IMPACT ON THE ECONOMY

NASA's aeronautics program is fundamental to the future of an American industry that has one million jobs. Aerospace cut jobs in 1992 by 130,000 (or 11 percent) to 1.05 million. Predicted employment for 1993 is expected to fall another 10 percent to 942,000. This would be the first time since 1978 that aerospace jobs would fall below one million. In 1992, U.S. producers shipped \$37 billion in civil aircraft, as

well as engines and parts with the largest share attributable to the commercial transport industry. The aerospace industry as a whole exported \$45 billion in products and had a net trade surplus of \$31 million. More than 80 percent of exports were civil aircraft and related shipments. Exports of complete transport aircraft alone were worth \$22 billion. The importance of the large civil aircraft sector as a positive contributor to our nation's trade balance and economy on the whole is indisputable.

We must increase investment in commercially-oriented aeronautical technology. Despite the enormous return the country has experienced from its investment in civil aeronautics technology, the share of NASA funding devoted to this important area of research and technology development has been insufficient in recent years. As a share of total NASA budget authority, funding for aeronautics declined from more than 12 percent to less than eight percent between 1979 and 1991. The budget for FY 1993 included \$865.6 million in funding for civil aeronautics R&T; whereas proposed funding for FY 1994 totals \$1 billion. Our industry applauds this 17.9 percent increase along with the majority increase of funding allocated for subsonic research and technology.

We also hope to see systems technology with near-term competitive payoff receive increased emphasis within NASA. This "proof of concept" work drives down the risk of applying new technology for private companies, who must invest enormous sums to develop new model aircraft and major components such as engines.

Advances in civil aircraft once came from step-by-step gains in individual technical fields such as low drag airfoils or more efficient engines. Today, it is just as important to validate systems or technologies working together—such as demonstrating the interactive aerodynamics of engine, nacelle, and wing to achieve heightened total performance. It is also critical to explore new technologies, to learn for example, how composite materials will perform and last under a variety of conditions.

Commercial success depends upon improving these kinds of technical achievements, and reducing the time between technology development and its application in a product. Currently, AIA in concert with its educational foundation, the National Center for Advanced Technologies (NCAT), is working towards this goal by coordinating industry, government and academia efforts in technology research and development. NCAT has identified key or critical technologies needed for future maintenance of U.S. technology superiority and is currently working with NASA and DoD to facilitate technology DEMOS—demonstrations of engineering and manufacturing operations systems. In the field of subsonic aircraft it is estimated that aeronautical technology gaps are underfunded by \$1 billion per year.

BASIC RESEARCH AND TECHNOLOGY

NASA's strongest focus is on basic R&T and it has an excellent program covering important areas. However, U.S. manufacturers face technical challenges that are not being addressed. For example, additional basic rotorcraft research is needed. Even small improvements in helicopter performance could confer major market advantages to offset U.S. market share declines. Many believe that aircraft such as the V-22 tiltrotor hold considerable promise for relieving congestion in civil transportation, and could greatly expand U.S. manufacturers markets.

Also, basic research is underway on advanced materials for propulsion systems, but there are no plans for technology demonstrations to validate their use in a gas turbine engine.

NASA is doing substantial research in aging aircraft, and fly-by-light/power-by-wire, which are critical areas for advanced subsonic applications. Research in technologies at the heart of the next-generation airspace system is also necessary to help the U.S. stay competitive. Emerging technologies include integrated advanced guidance, flight management, and information transfer technologies in advanced air traffic management and cockpit systems; wake vortex prediction, amelioration, detection, and avoidance; and enhanced situation awareness concepts that allow better operation in adverse weather conditions. These technologies should be developed by NASA and other government agencies, including the FAA, working together with industry.

Today's state-of-the art technology in engine noise suppression does not indicate that the industry will be able to exceed appreciably the current Stage 3 limits, which call for the phaseout of noisier Stage 2 operations, by the year 2000. Current U.S. technology is the best available. Although a noise reduction technology development program could take from six to eight years despite constant increasing demand from the public for a quieter environment—such a program has not been fund-

ed, in recent years, outside of industry efforts. Industry salutes NASA's initiative to fund by \$29.5 million, noise reduction research and technology.

Supersonic Transport

Fully funding the High Speed Civil Transport (HSCT) program, as long as goals seem achievable, will keep the U.S. in the forefront in this area of high potential aeronautics technology. It is important that work begin now to allow certification of an aircraft in the 2005-2010 time frame. Challenging technical hurdles to be faced include, first, making a system that is environmentally sound, and achieving cost competitiveness with the best subsonic jet transports.

Aeronautical Test Facilities

U.S. transport technology leadership requires new, practical, less expensive, highly efficient wings and high-lift but, U.S. test facilities are inadequate to do the necessary work. Existing tunnels have deteriorated and are undergoing reconstruction. U.S. companies, despite concerns about the confidentiality of test data, are using European facilities. U.S. firms have also begun to use the wind tunnel capabilities of the former Soviet Union and it is possible that Russia could yet become a major competitor in commercial aircraft production. Increased funding to maintain and develop critical test facilities should be implemented. It is our understanding that NASA intends to invest approximately \$1 billion in facility upgrades. Industry supports this increase.

Agency Coordination

Greater synergy between civil and military technology development makes sense as the U.S. moves in the direction of a single, flexible industrial base that supports both defense and civil market requirements. The U.S. should take a coordinated approach to civil aeronautics technology development during this era of economic and political change. Relevant technology should be shared and supported by NASA, the Department of Defense, the Federal Aviation Administration, and other agencies. Industry must have a leading role in this process. There is too much at stake to allow artificial barriers that limit our technological progress. With teamwork, we can lead in terms of new technology solutions and technology affordability. We need to emphasize both if we are to maintain global market leadership.

S. 419—Aeronautical Consortium Act of 1993

Industry applauds Senator Danforth (D-MO) for his efforts in highlighting the importance of the aircraft and aeronautics industry to the health of our economy. Through the introduction of S. 419, the Aeronautical Technology Consortium Act of 1993, the debate on how the U.S. should remain competitive in this country's leading exports commenced.

We have asked our members for their views on this approach. In performing their review of this legislation, AIA's member companies have divergent opinions on various provisions. In general, there is agreement with the need to have a more coordinated approach among the Federal agencies. However, we are in general skeptical that this Sematech-like model is appropriate for the aerospace industry. Sematech was established to pursue a single goal. The challenges facing the aviation industry in the U.S. are complex, and differ from one segment to another. We are also concerned that the Aerotech model may be inconsistent with the provisions of the U.S.-EC bilateral agreement covering subsidies to large civil aircraft and may be exceeding the limits on government support that are established in the agreement.

However, we do believe the government can provide a better business climate in which industry can reduce costs, pursue new markets, and increase their capability to compete internationally. We believe Congress can focus its attention on the following regulatory and legislative impediments, which if removed, could provide industry with the ability to become more competitive.

Reducing Unnecessary Cost

Let me address a range of factors that are driving up cost for American industry.

First, the cost of regulation. Federal regulations have played an important role in the demand for aviation products and services by building confidence in air travel. They provide guidance in design and manufacture, operation, service and maintenance. They contribute to safety and durability of aircraft and their systems and parts. But regulation imposes costs, too, and therefore affects an aircraft's price, marketability, and operating costs.

The major obstacle to regulatory cost control is varying national and regional aviation authority requirements. Differences between the U.S. Federal Aviation Regulations (FARs) and the European Joint Airworthiness Requirements (JARs) mean numerous design modifications, redundant testing and certification processes. We

need to move as swiftly as possible to a single certification system. The FAA must be adequately funded to support this effort. In particular, the aircraft certification service and the flight standards service need increased funding to support and expanding workload.

Our industry also believes that our civil aviation regulatory process suffers from lack of overall strategy. Regulations and airworthiness directives have increased without sufficient consideration of priorities or cost-benefit analyses. There is duplication, inconsistency of interpretation, and the growing number of directives often do nothing to enhance crew and passenger safety. There is movement on FAA's part to take a more sensible rulemaking approach. We would like to see regulatory action based on an undeniable connection between accident history and regulation. A priority-weighted regulatory strategy based on safety return per dollar spent will make our skies safer and our manufacturers more competitive. These areas have been identified by AIA as well as the airlines on several occasions.

The airlines also struggle with costs generated by the ever-increasing issuance of FAA Airworthiness Directives. Although there are other and better ways to correct deficiencies, the number of ADs issued annually has quadrupled since the 1980s. Issuance of unnecessary ADs plays havoc with airline schedules, for little return in safety enhancement.

I can't leave the issue of regulation without mentioning environmental concerns. Our industry has for many years been pushing to develop the technology to meet aircraft noise requirements and to control pollutants released by aircraft in flight and during manufacturing processes. We have achieved a great deal but not enough to meet the most stringent demands being imposed. With respect to noise, we must seek solutions that balance the public's interest in quiet communities, the technical feasibility of achieving further reductions in aircraft noise, and the ability of the airlines to afford these new, quiet aircraft. Communities will have to help find the solutions through better land use planning. As for emissions and manufacturing processes, let us set timetables that are reasonable in light of industry's dedicated search for solutions. We are pushing the boundary of current engine technology now with respect to noise and emissions. In manufacturing, we are pressed in some instances to find substitute processes where none yet exist. Nor can we compromise safety. Let's instead set timetables for achieving environmental goals that are reasonable and consistent with technology capabilities to meet new standards.

Finally, there are two other areas of policy that affect the cost of American civil aircraft manufacture, one is health care. There has been so much attention to this issue thus far in the Clinton Administration that I don't think I need to say a great deal except to point out that aircraft industry health insurance costs are rising faster, and exceeding, those in the U.S. manufacturing sector as a whole. That's something we just can't afford. Reasonable legislative and regulatory reforms of the nation's health care delivery system are essential.

A second issue is current antitrust laws which are unsuited to industries that are engaged in global production and markets, and facing strong foreign competition. Such is certainly the case with the aircraft industry. We believe U.S. antitrust laws and policies should be amended to permit domestic cooperation through production and marketing of a product where there is effective foreign competition and targeting of U.S. firms. We are aware of current efforts in both the House and Senate to amend the National Cooperative Research Act of 1984 to rectify this problem and support these legislative efforts.

There are a number of other areas that affect our market position that we must address without delay, our aviation infrastructure, export controls and export financing.

Aviation Infrastructure

The airlines are our customers, and what affects them affects us. The health of U.S. airlines is especially important because they provide U.S. passenger jet manufacturers with the solid base of demand needed to maintain production schedules and launch new aircraft programs. Over the next several years, 40 percent of commercial jets on order from U.S. manufacturers will be delivered to U.S. airlines.

However, the precarious financial position of U.S. airlines is no secret. Unable to change today's difficult market conditions, airlines have focused on cutting costs through operating efficiencies. This is no easy task; the airlines are under cost pressures from every side.

The physical infrastructure itself works against reducing costs. We need new airports and runways to reduce delays. We need to remove limitations in the air traffic control system and ATC procedures that lead to inefficient airspace and ground operations. Relief from these problems is tied to aggressive implementation of the

Aviation System Capital Investment Plan and greater use of Aviation Trust Fund monies to pay for airport improvements.

Export Controls

In the face of government-supported competition, there is little sense in handicapping ourselves with unilateral export controls that reflect our foreign policy agenda. Seldom do such controls accomplish their objective. At the same time, they disrupt aircraft buying and selling relationships that are typically long-term arrangements. U.S. foreign policy shifts are well-known in the marketplace and give us a reputation as an unreliable supplier. Again, if our competitor gets the sale today, because we cannot offer the financing or because of unilateral controls, then our competitor will benefit for several decades to come. And when we lose sales because our export control bureaucracy is bogged down by product definitions and jurisdictional disputes and cannot move quickly enough, and we do lose sales for those reasons, then the U.S. has only itself to blame. Inappropriate use of export controls also provides an incentive for foreign manufacturers to design U.S. content out of their products in order to eliminate the ability of the U.S. to affect their ability to market their products.

Export Financing

In the civil aircraft industry, a sale lost through lack of financing actually entails a stream of lost sales—of the same or follow-on models, of parts, and spares—over a period of 15 to 30 years. That is why the Export-Import Bank must have the resources to support the industry against foreign competitive financing. It should also be in a financial position to tailor programs to meet gaps in the market. In these tough economic times, many willing customers for U.S. aircraft and engines will look elsewhere if financing is not available. They may not want to, but they will have no choice. The U.S. must help them make the choice—in favor of American products.

AIA appreciates the interest shown by your committee, Congress, and the Administration in looking for ways to support aviation in the United States. We stand ready to assist you at any time on the issues addressed in our statement and submissions for the record, as well as any other issues that you may want to discuss. I would be pleased to answer any questions you may have at this time.

[AIA's "Industry Competitive Enhancement (ICE) Initiatives," February 1993, and "The U.S. Civil Aircraft Industry—Can It Retain Leadership?" may be found in the committee files.]

Senator DANFORTH. Thank you very much.

Mr. Pettee.

STATEMENT OF TIMOTHY PETTEE, VICE PRESIDENT, ALLIANCE CAPITAL MANAGEMENT CORP.

Mr. PETTEE. Thank you, Senator.

I, too, would like to summarize and excerpt my statement, which has been submitted for the record.

Mr. Chairman, the committee's desire to investigate the state of the commercial aerospace industry, particularly that of its U.S. participants, is indeed timely.

After an unprecedented boom in commercial aircraft orders in the late-1980's, the industry peaked in 1991, with a record 844 aircraft delivered. Industry now is in the midst of a steep business decline. If history repeats itself and the downturn of the 1970's and 1980's are repeated, then the decline is not even halfway over.

Such a business cycle would have a profound effect on the competitive structure of the aircraft manufacturing industry. Already, plans to dismiss 50,000 workers in just the commercial segment of the aerospace industry have been announced by the engine and airframe manufacturers. The total industry job loss amidst a "typical decline," including those of the suppliers, could be two to three times that 50,000 figure.

Many factors have contributed to the industry's current decline, including the severe impact of war and recession on air travel, an acute and prolific capital crisis that has plagued the airline industry, an ebbing more recently of high growth and profitable international markets, and, in my opinion, the failed hub and spoke strategies of the major U.S. carriers.

But there are encouraging signs the industry may be able to right itself. Airline traffic and revenues in the U.S. market, which makes up more than one-third of the total worldwide market, have begun to show improvement. Foreign airline markets appear to be stabilizing, although there is ample evidence non-U.S. airline markets will lag the U.S. recovery.

Aircraft groundings and retirements, which spiked to unprecedented levels in the last 18 months, appear to have peaked, evidenced in part by airline demand for spare parts picking up in recent months. Orders for new aircraft over the last 6 months have been greater than the prior 12 months. And some believe 1993 orders may exceed that of 1992's level of \$27 billion.

Barring a dreaded double-dip economy, 1994 orders should be comparable or better than this year's. This suggests that the trough for the commercial aircraft industry may be in 1994, one year sooner than the historical precedent might have otherwise suggested.

Now, amidst the order boom of the late-1980's and the subsequent downturn, market shares of the three major participants have shifted. Boeing, with a broad family of products, continues to enjoy a 55- to 60-percent share of the market. Airbus Industries, however, the European consortium, has seen its share of the market rise steadily to a cumulative 16 percent as of year-end 1992, although its share of recent orders, as noted earlier in the hearing here, has been as high as 30 percent.

On the other hand, McDonnell-Douglas has seen its cumulative share of the market decline to 19 percent, and McDonnell-Douglas has captured a very small share of recent order activity, raising some questions about McDonnell-Douglas' ability to remain competitive.

Now, besides the need for a family of products, success in the commercial aircraft industry will be a function of the development of world-class engineering and manufacturing processes, while enhancing quality, which all three of the major players are accomplishing. As importantly, near-term success—orders, in other words—may be measured by the ability of the manufacturers to provide customer financial support, at least until the airline industry develops sustainable access to capital.

And therein is my message to you today, Senator. S. 419 and other suggestions appear aimed at providing direct legislative benefit to the commercial aircraft industry. No doubt, the severe downturn the industry has experienced over the last 2 years is cause for concern. However, as noted in my prepared remarks, there are strong indications the industry will cyclically right itself, perhaps as early as next year. Further, U.S. manufacturers' participation in this industry is alive and thriving, albeit more heavily concentrated recently toward the Boeing Co.

Therefore, it would appear the greatest legislative impact the Congress could have on the commercial aircraft industry would be to help the ailing, financially troubled, capital starved airline industry. This committee will no doubt take an active look at the recommendations made by the legislatively empowered 15-member panel to study the competitiveness of the U.S. airline industry.

Those in the financial community, including myself, would no doubt conclude measures aimed at enhancing the creditworthiness of the airline industry, such as with loan guarantees, could have a profound impact on airline aircraft orders. In addition, as industry participants have cried out and Mr. Wolf mentioned earlier, the industry needs relief from the heavy tax and fee burdens placed upon it.

I hope the committee will hear the airline's plight and act to provide relief to the airline industry to the direct benefit of the traveling public and the indirect benefit of the commercial aircraft industry.

I, too, would be happy to take any questions.

[The prepared statement of Mr. Pettee follows:]

PREPARED STATEMENT OF TIMOTHY PETTEE

INTRODUCTION AND SUMMARY STATEMENT

Thank you, Mr. Chairman, members of the committee and staff for the opportunity to address you today concerning the state of the aircraft manufacturing industry. I am the transportation and aerospace industries research analyst with Alliance Capital Management. Alliance is one of the country's largest pension and mutual fund managers in the United States with assets under management of approximately \$65 billion. The firm's clients include corporate pension funds, among them several of the Fortune 100 largest U.S. industrial concerns, state and city pension funds, foundations as well as various mutual fund products. My responsibilities are to research and recommend appropriate equity securities for inclusion in the firms pension account portfolios and mutual funds. While I am responsible for the research the commercial aerospace industry, I have developed a degree of expertise in research and analyzing the airline industry, having specialized in airline industry research for major Wall Street brokerage firms prior to joining Alliance in 1990. In addition I am currently in my third term as president of the Society of Airline Analysts.

Mr. Chairman, the committee's desire to investigate the state of the commercial aerospace industry, particularly that of its U.S. participants is indeed timely. After an unprecedented boom in commercial aircraft orders in the late 1980s, the industry peaked in 1991 with a record number of aircraft delivered and is now in the midst of a steep business decline. If history repeats itself and the downturns of the 1970s and 1980s are repeated, then the decline is not even half way over. Such a business cycle would have a profound effect on the competitive structure of the aircraft manufacturing industry. Already plans to dismiss 50,000 workers in just the commercial segment of the aerospace industry have been announced by just the engine and airframe manufacturers. The total industry job loss amidst a "typical" decline, including suppliers, could be two to three times the 50,000 figure.

Many factors contributed to the industry's current decline, including the failed hub and spoke strategies of U.S. airlines, an acute and prolific capital crisis, and more recently an ebbing and in some cases a decline in high growth international markets. But there are encouraging signs the industry may be able to right itself. Airline traffic and revenues in the U.S. market, which makes up more than one-third of the total worldwide market for airline services, have begun to show improvement. Foreign airline markets appear to be stabilizing, although there is ample evidence non U.S. airline markets will lag the U.S. recovery. Aircraft groundings and retirements, which spiked to unprecedented levels in the last 18 months, appear to have peaked, evidenced in part by airline demand for spare parts picking up in recent months. Orders for new aircraft over the last six months have been greater than the prior twelve, and 1993 orders will likely exceed that of 1992. Barring a dreaded double dip economy, 1994 orders should be comparable or better than this year's. This suggests the trough for the commercial aircraft industry may

be in 1994—one year sooner than historical precedent might have otherwise suggested.

Amidst the order boom of the late 1980s and the subsequent downturn, market shares of the three major participants have shifted. Airbus Industries, the European consortium, has seen its share of the market rise steadily to a cumulative 16 percent as of year end 1992, although its share of recent orders has been substantially higher than that level. The McDonnell Douglas Corporation has seen its cumulative share of the market decline modestly to 19 percent. However, McDonnell Douglas has captured a very small share of recent order activity, raising questions about McDonnell Douglas' ability to remain competitive. But before one engages in debating the comparative avenues to capital between Airbus and its U.S. competitors, one should note that Airbus, like Boeing, has developed an impressive array, indeed a family, of aircraft that serve the needs of many an airline around the world.

Besides the need for a family of products, success in the commercial aircraft industry will be a function of the development of world class engineering and manufacturing processes while enhancing quality, which all three of the major players are accomplishing. As importantly, success has recently and will continue to be measured by the ability of the manufacturers to provide customer financing support, at least until the airline industry develops sustainable access to capital. But by far the most important factor in the commercial aircraft industry's success will be the degree to which the airlines of the world, particularly those in the United States, are able to recover and prosper after an unprecedented, for most any industry, decline begun in 1990 and which has amounted to worldwide losses since then of more than \$20 billion.

WHERE ARE WE IN THE CYCLE

The commercial aircraft industry is in the midst of a major cyclical downturn after a record 844 new jet aircraft deliveries in 1991, including more than 600 deliveries by the two U.S. manufacturers. Since that peak, which coincided with the airline industry's coping with the Persian Gulf conflict and recession in the United States, manufacturers have been forced to cut production rates to meet the sharply lower demand for new aircraft. Manufacturers have been themselves forced to cope with rapidly changing airline delivery schedules, with in some instances carriers canceling aircraft orders within months of scheduled delivery. There is no worse condition for the aircraft manufacturing industry than having to maintain large levels of undeliverable finished aircraft inventory, as appears to have occurred in certain circumstances recently and may continue to occur in 1993. Based on historical precedent—the cyclical downturns of the mid 1970s and early 1980s—the industry may not show improvement until 1996.

As with past cycles, the industry stands to record a severe contraction in employment levels. Commercial aircraft manufacturing and related staffing levels fell by approximately 40 percent from peak to trough in the above noted cyclical downturns. At its most recent peak two years ago, U.S. aircraft manufacturing jobs totaled nearly 300,000, excluding an estimated 150,000 additional jobs at hundreds of large and small suppliers to the major manufacturers. Already, U.S. airframe and engine manufacturers have cut 20,000 workers from their payrolls, with planned cuts likely to exceed a total of 50,000. If the current cycle is anything like the downturn of the 1970s and 1980s, the 50,000 figure cited by the manufacturers could increase markedly. In addition, suppliers to the industry will likely record job losses of as much as the manufacturers themselves.

The above figures refer to the commercial aircraft operations of the major manufacturers, and would be additive to the tens of thousands of job cuts owing to the expected decline and restructuring of the nation's defense budget.

And, as was the case with the early 1980s, the U.S. industry may not emerge as vibrant as it was going into the current downturn. Buffeted by a highly competitive sales and marketing environment, worldwide airline recessionary conditions, and high manufacturing and engineering costs, the Lockheed Corporation exited the commercial aircraft market in 1981 after a long and illustrative participation in the industry. Some parallels exist between Lockheed's plight in the late 1970s and early 1980s and the plight currently confronting McDonnell Douglas' commercial aircraft division today.

CONDITIONS LEADING UP TO THE CURRENT DECLINE

The fortunes of the commercial aircraft industry are obviously a function of its customers—the world's airlines. During the 1980s, several countries embarked upon a common policy of deregulating domestic, and in some cases international, airline services. Other than the widely debated deregulation of the U.S. market, airline reg-

ulations were eased or lifted entirely during the 1980s in Canada, Mexico, Australia, India, and the United Kingdom to name just a few. The common denominator of deregulation policies throughout the world was to remove government price controls to make air travel more affordable to more travelers than ever before. While debate continues in the United States and elsewhere as to deregulation's benefits, or lack thereof, there should be little debate that on the hoped for reductions in the real cost of air travel, deregulation was a marked success. In the United States, the real cost of air travel declined by over 20 percent in the 1980s, and demand, quite expectedly, soared. Airline traffic rose by double digit rates in the U.S. in the mid to late 1980s, spurred in part by numerous and prolific new entrant airlines.

The worldwide deregulation impetus had a stimulative impact to the commercial aircraft industry, as orders for new aircraft nearly doubled in 1985 from year earlier levels to approximately \$32 billion. At the same time, airline strategic planning efforts underwent profound change that was to serve to spur aircraft orders to previously unimaginable levels. The most significant change in the airline industry's planning involved formation of hub and spoke route systems, as opposed to the more linear, point-to-point services the industry historically sought. Driving the hub and spoke route system phenomena was the significant decline in the average realization (yield) per passenger owing to the effects of deregulation on the costs of air travel. As a result of lower revenue realization, airlines sought to minimize costs, while maximizing the number of markets it could serve. The hub and spoke system, in which the number of markets served grew exponentially with each additional city added to the hub., provided the answer for most of the U.S. carriers and many of the world's airlines. In the early 1980s, less than five major airline hub and spoke centers, or "complexes" existed in the U.S. By 1990, there were more than 25 such complexes. Some cities enjoyed the benefits of two competing airline hub and spoke systems at the same airport.

As more cities were added to the multiple hubs of multiple airlines, carriers needed an abundance of narrow bodied, cost efficient aircraft to serve smaller city pairs, and wide bodied aircraft to serve the larger city pair markets, which benefited from the connecting feed traffic from those smaller cities. Contributing to the demand for seats and aircraft by the world's airlines was the fact that many hubs created modestly circuitous routings in serving many city pairs. So, as airline hubs proliferated, so did the demand for new aircraft. In 1989, orders for new aircraft ballooned to approximately \$95 billion, nearly three times the level of 1985 and an eight-fold increase from 1983.

In retrospect, the airline industry has been unable to finance the appetite for new aircraft that developed in the late 1980s. At the time, however, various forms of capital appeared to be abundant, and were expected to proliferate. Buoyed by strong earnings and the highest margins achieved post deregulation, airlines' costs of capital declined markedly resulting in attractive public debt and equity financing. Of course at this time billions of dollars were committed toward the leveraged buyout of Northwest Airlines and the proposed leveraged buyout of United Airlines. In addition to attractive public markets, private debt and equity markets emerged. Cross border financing, particularly Japanese leveraged lease transactions provided billions of dollars of aircraft financing. Leasing companies, including but certainly not limited to International Lease Finance Corporation and Irish-based GPA Group, proliferated as carriers sought certain degrees of flexibility in managing their fleets. And lastly, strong overall corporate earnings created a strong market for tax advantaged debt financing by many U.S. multinational companies with finance arms, in the wake of the tax reform legislation of 1986.

Lastly, a major factor contributing to the proliferation of aircraft orders in the late 1980s was a growing number of international market opportunities for U.S. and non U.S. carriers. This was in part borne out of U.S. carriers desire to extend the economics of their growing hub and spoke route systems. Hence where ever bilateral treaties allowed, U.S. carriers began services to Europe and Asia from their domestic U.S. hubs. simultaneously, the U.S. department of Transportation developed and pursued an "open skies" strategy which in some cases has served to expand international market opportunities for both U.S. and foreign carriers. What is more, the prospect of liberalization of European markets and more importantly, the growth of Asian economies, particularly Japan, served to spur growth prospects for the commercial aircraft industry.

WHAT WENT WRONG

While war and recession in 1991 and 1992, respectively, wreaked havoc on the airline industry, the seeds of subsequent problems in the commercial aircraft industry were sowed unrelated to these exogenous events. The boom in aircraft orders

noted above included a modest degree of speculation among leasing companies and to a lesser extent airlines themselves. Such speculative orders proved difficult to place with lessees. And a rash of bankruptcies and failures in the U.S. and foreign markets touched off a capital crisis that persists today. However, in my estimation, a large, increasingly recognized factor contributing to the commercial aircraft industry's inability to sustain prosperity was the failure of the U.S. carriers' hub and spoke route strategies, which will likely result in a markedly different order cycle when the industry downturn has run its course.

Simply put, hubs have not worked. On the cost side of the ledger, the hub and spoke route systems failed to minimize the total costs—operating and ownership—of the vast hub and spoke complexes. As noted above, the theory behind the hub and spoke route system strategy was in effect to grow capacity at a rate faster than absolute increases in costs, thus achieving significant economies of scale and growth and driving down unit costs. However, because of rapid and unforeseen advances in "infrastructure" related costs, which permeate several different line items in airline profit and loss statements, airlines have been unable to achieve sought after economies of scale and unit cost declines. In fact infrastructure related costs, which could broadly include facilities costs, training, and aircraft related capital costs, have risen at significantly greater rates than that of capacity. Costs of airport related charges have risen sharply, including terminal rentals and capital costs, landing fees, and aircraft servicing costs. Tremendous investments were made in maintenance facilities to service growing aircraft fleets only to see certain of these facilities operate at less than 50 percent of available utilization, driving up unit costs. And costs of capital related to aircraft acquisitions, and rentals, jumped well ahead of strategic parameters. And on the revenue side, hub and spoke route systems served to minimize yields, due in part to the proliferation of competitive hub cities and the marginal pricing policies applied toward feed, or connecting, traffic into and out of the hubs.

As a result of the failed hub strategies in the U.S., which has impacted airline strategic planning in other regions of the world, many major carriers are looking to phase out ambitious new hub projects begun in the 1980s. Coupled with a likely reduction in marginal feed market services at existing hubs, it is likely capacity growth for the airline industry, a direct indicator of commercial aircraft needs will only total approximately 2 percent in the U.S. in the 1990s, versus the 4.5 percent rate posted in the 1980s. The bulk of the reduced demand for new aircraft will likely fall upon narrow bodied products, with scheduled deliveries and future orders likely only to replace existing narrow bodied aircraft as opposed to be use as growth vehicles.

Regarding the capital crisis permeating the airline industry today, relatively new and some longstanding sources of capital for the industry have dried up indefinitely. As industry profitability and cash flows plummeted amidst the exogenous bumps of 1991, airline capital spending plans became far too ambitious. Rating agencies began a multi stepped, three year process of downgrading the relative ratings assigned to industry debt instruments, culminating earlier this year when the airline group for the most part was accorded "junk" bond status. While this was occurring the costs of capital incurred by the industry soared, such that the estimated cost of debt and equity capital of the U.S. big three carriers is in excess of 11 percent—a rate of return the carriers could not even hope for in the most robust of years.

In addition, the cross border financing market was imperiled by tax law changes in foreign countries as well as the downturn in overall corporate profits, which dealt a heavy blow to the incentive for U.S. multinational finance arms to bank the airline industry. And of course the order speculation of certain of the leasing companies, most notably GPA, drove up the costs of previously cost effective and flexible operating leases.

SIGNS OF RECOVERY

Despite the broad strokes of doom and gloom painted above, there are encouraging indications the commercial aircraft industry downturn, begun in 1991, may bottom out in 1994, a shorter (albeit as severe) downturn than those experienced in the mid 1970s and early 1980s.

The most encouraging indicator in the U.S. is a rebound in domestic traffic growth experienced by U.S. carriers since last December. While that growth may moderate later this year when compared with deep discount driven traffic of 1992, overall revenue growth trends are expected to continue to improve at the rate of about 5 percent. Offsetting this somewhat are disturbing revenue trends in foreign markets, particularly the economically weak European markets. And transatlantic and transpacific market revenue trends for U.S. and foreign carriers alike are not improving.

A second sign of recovery is that spare parts orders reported by major airframe and particularly engine suppliers appeared to have bottomed out in the fourth quarter of 1992. The dramatic withdrawal and retirement of older aircraft—literally and figuratively referred to as sent to the desert—appears to have ebbed. Several major airlines have indicated retirements will now match new aircraft deliveries, not the most encouraging sign to the aircraft manufacturers but certainly better than trends of late 1992.

Thirdly, new aircraft orders appear to have picked up. Orders totaled approximately \$27 billion in 1992, down sharply from the peak \$95 billion figure attained in 1989 noted earlier. However, several recent orders suggest 1993 total orders may exceed \$30 billion, a modest uptick from last year's level. Contributing to recent order activity has been the need for certain carriers to meet certain federal and local noise requirements as well as aggressive financing incentives and terms provided certain buyers in a heavily competitive industry environment against the backdrop of low absolute interest rates.

Senator DANFORTH. Thank you all very much for your testimony.

We realize—I think all of us on the committee realize the problem of the aircraft manufacturing industry and the problem of the airline industry are interrelated. And with respect to the aircraft industry and the airline industry, there are a number of subparts to the problem, and there could be really quite a list and should be quite a list of the things that we need to try to fix the problem.

I want to ask your judgment on the basic idea of S. 419, and let me say that I just want your honest answer. You are not going to hurt my feelings. The idea was that if we are going to have a competitive aircraft manufacturing industry, we are going to need to develop new products. Some have pointed out today the need for new manufacturing technologies, as well as the new generation of aircraft.

Then, if that is going to be done, there is going to have to be a possibility of consortiums within the United States. And, further, there is going to have to be the possibility of some kind of relationship between what Government is doing, now spending \$10 billion a year on research and development, and what the directions and the needs of the private sector are. Hence, S. 419.

The model was SEMATECH. Various witnesses have said today—I think all of you have said—that you do not think SEMATECH is a very good model for the aerospace industry. Do you think that this idea of—I mean is it your honest view that this idea of trying to do something SEMATECH-like—you know, the very name Aerotech connotes SEMATECH—is a mistaken idea and that we should really focus our attention on more direct needs or other needs of the aerospace industry? Or do you think that the concept is something that we should proceed with, maybe in some modified form?

Mr. Wolf.

Mr. WOLF. I would like to comment on that. First, there is a lot of likeness with SEMATECH in the fact that we see Aerotech aimed at keeping in the industry on the leading edge of technology, and that is absolutely essential. And a SEMATECH-like structure may very well work, but I think we have to recognize that because of the diversity we are going to need to be flexible.

Let me just use as an example the range of technologies that are really being addressed here. It has been mentioned this morning the general aviation industry, which encompasses a different kind and different set of technologies than the large aircraft business. Within the large aircraft business there is airframe technologies as-

sociated with basic materials, fabrication and assembly, engines, avionics, control systems, aerodynamics, and literally encompassing thousands of suppliers.

To put together a single consortium, as was done with SEMATECH, around a relatively small number of core technologies that would enhance component capability is not going to be applicable to this diversity. It will take one set of interests to be built around those things that will help manufacturing technology and product technology for airframers, and perhaps a different kind of group that would attack the technologies of engines, and yet another on avionics.

So, within the general framework of the idea of industry working together with the Government to zero in on the critical elements and to form those groups necessary to attack those to stay on the leading of technology, the answer is absolutely, yes. It is definitely in the right direction, and we support it.

Senator DANFORTH. Mr. Hudson.

Mr. HUDSON. The industry association, as we reviewed this as members, found general support, but concern about exactly how it would be applied. Again, the breadth of our industry and using the SEMATECH model, which focused on one key technology for that computer industry and many of our microprocessor industries, was stretched.

The umbrella idea of Government-industry cooperation and consortiums, picking areas where we can work together—I think our industry association has picked one in particular. Aircraft hardening, where we do have industry elements working together under a grant from the FAA on that particular case, where we are doing good work on a noncompetitive basis, but a very important piece in our international well being for our industry is a good example of where we have done this.

But there is concern about trying to put everything into one basket. So, I think what we were recommending and we were feeling was that we needed to go about it in an orderly fashion in deciding, but with the degree of urgency that you have mentioned and the other Senators have mentioned today, and finding those areas where we can do something and move out swiftly.

So, I think that is the direction we would point.

Senator DANFORTH. So, should we proceed with this? I mean are we going down the right trail here, or is it your view that it is just really a faulty idea?

Mr. HUDSON. We think it is a sound idea. We think it needs to be tailored to the particular industry in question. That would be our direction.

Senator DANFORTH. OK. Mr. Pettee.

Mr. PETTEE. Well, Senator, I think I would confess to noting that I personally—I think other members of the financial community would prefer that the private markets determine and continue to fund research and development efforts in the industry. I have talked to other members of the financial community about S. 419. I think the financial analysts and observers in the industry would echo Mike's concern and comments regarding how such funding would work and how equity—fairness would be applied to various program efforts.

I would note that new product development in the U.S. industry is not bad. I recognize John's plight at Douglas Aircraft with respect to new products. But, at Boeing, there is an astounding plethora of research and development effort and new products coming down the pipe, the first of which will be—or one of which will be the triple-seven in a couple of years.

And while such information is held, you know, closely to the chest in the industry, I have a nagging suspicion that there are two or three additional products that Boeing will be bringing to the market in the late-nineties that are taking up the bulk of their \$2 billion R&D effort on an annual basis; which, by the way, is augmented by another \$2 to \$3 billion that they are spending on the capital expenditure side—plant, facilities, et cetera.

So, I guess I would confess to raising the private market flag on this issue and, as my testimony points out, prefer to redirect the efforts at the customer base, which is really, really hurting. I mean, I cannot underscore that enough.

Senator DANFORTH. I understand that. I mean I understand that there are a lot of needs and I agree with that. I mean I agree that the health of the airlines is certainly the key to it. This is admittedly an effort to look at a fraction of a large problem.

But your basic view is that, you know, whatever is done is being done, as far as research is concerned, and that this smacks of governmental involvement, even though the heart of it really is to allow the private sector to have input into how the Government is spending its \$10 billion in research?

Mr. PETTEE. Yes, I would agree with that. I would note that I am an outsider. You know, I am on the outside looking in. And I am looking at industry demand right now, which, you know, is in the midst of what I hope is only a 3-year decline, but could be substantially worse than that.

All the while, it looks like new products will be coming to the market.

Mr. WOLF. May I add a footnote? I think we are talking about two levels of investment. One is at a basic, core research level to reduce the risk of long leadtime technologies which are on the leading edge. Boeing already participates with the government and with other members of industry as we do in the development of these kinds of technologies.

So, I believe that we airframers would be able to participate in a framework such as you are suggesting for these leading edge, high risk technologies. The development of those and the application of those technologies to a particular product, which does encompass significant investment, is what we traditionally take on ourselves, and which would not be applicable to this form of a consortium. And I believe that is the particular nature in which my colleague is referring to at Boeing.

We also are making very significant investments in next generation products. We are continuing to do that today with the MD-90 that is in the process of certification. And those dollars are usually more significant than the high-risk technology dollars. But at the same time, it is very important that we do band together to look at those very long lead, high-risk technologies.

Senator DANFORTH. Let me just ask you one other question, Mr. Wolf. Increasingly groups of aircraft manufacturers band together to create a product. Certainly this has been true in the defense industry, and apparently is increasingly becoming true in the commercial aircraft business also.

Many of these joint ventures are U.S. companies looking abroad, whether it is Airbus, Taiwan, wherever they are looking, to put something together. Should the partners in such efforts be—and I do not want to suggest that they should not be foreign entities. But what I want to ask, is there any particular reason why they are foreign entities rather than U.S. entities?

Mr. WOLF. I think it is a natural consequence of the direction the industry is heading for reasons that have been voiced earlier. There will be alliances formed. There is no single company anywhere in the world that can by themselves afford the total nonrecurring cost of developing a new large aircraft product. Boeing has indicated that it has no intention of going at it alone in the future with very large aircraft or its next generation products, just as we have indicated that we intend to do it with partners. Airbus, of course, already is a partnership.

Those alliances will form along the lines of basic capabilities, the prime manufacturers holding onto the integration, the design, and the assembly, flight test and certification activities, and drawing in the best possible resources to work together with those capabilities to produce major components and do other work related to the development of a product.

So, depending upon how the skill bases of the participants align, we will see that form. There is a natural reason for that to be international, and that is because the market base is international—71 percent of our backlog is an international backlog. And we will continue to need to serve the interests of foreign airlines, and do that in way that we understand how best to do business in those countries. And that is best done through a global alliance, we believe.

Senator DANFORTH. One of the comments that has been made with respect to any kind of a loan guarantee program for airlines is that a loan guarantee program for a U.S. airline could be a loan guarantee for the purpose of purchasing Airbus. Would you be concerned about that or do you think that that would just be a natural reflection of the global nature of aircraft manufacturing?

Mr. WOLF. First, I want to state that we believe that Airbus has had a very unfair advantage with respect to being able to provide capital to their customers. So, in addition to having much of the development cost subsidized for their products, they have also been able to provide, with in effect no balance sheet consequences, capital to their airline customers in the form of very low-cost leases or other forms of financing.

Since that already exists at Airbus, we need to somehow balance that, and we are certainly in favor of legislation which, number one, helps capitalize the airline, but somehow we need to solve the equation of the unfair balance between the U.S. suppliers and the European suppliers.

Senator DANFORTH. Well, I thought that the agreement that we reached with respect to Airbus was a terrible agreement because

I thought what it did was to condone an unfair advantage that Airbus had achieved through its subsidies, and specifically to condone the \$26 billion of back-subsidies. So, I do not share the positive view of the Commerce Department with respect to what was done with respect to Airbus.

But if we are going to have any kind of U.S. program which provides loan guarantees or other subsidies for the U.S. airline industry and then we restrict those subsidies so that they are only available to the purchase of U.S. aircraft, we might fall afoul of the very agreement that we reached with Airbus. I do not know.

Mr. WOLF. It is a dilemma that is going to have to be debated, but the fact that there are imbalances that exist in the European's ability to finance their customers, and the relative lack of the U.S. manufacturers to do the same is going to affect the near term marketplace statistics and the market share factors more than the development subsidies.

Senator DANFORTH. I am all for countervailing duties. I mean, I have got a bill on that.

Mr. PETTEE. Could I just add that if I may be so bold as to predict what the U.S. airlines might respond, and maybe you have talked to them about this dilemma, and I am thinking of Mr. Crandall, Mr. Wolf, Mr. Allen, and other of the participants.

While I am sure they would favor some sort of help to the aerospace industry and the airline industry, I do not think they would look favorably upon aircraft purchase decisions that exclude Airbus. American, Delta, United, Northwest, TWA, America-West—those are the ones that come to mind—have purchased and/or operate Airbus equipment. And sure, there are probably some very favorable terms that have been offered there.

Being a follower of the airline industry, I would hate to see the additional burdens placed upon the airline industry, albeit perhaps to the benefit of the U.S. manufacturers, by excluding Airbus or any other manufacturer, Fokker and others, the Germans, who may or may not participate in the market, from the competitive process.

Senator DANFORTH. Well, Mr. Pettee, there is not any competitive process. I mean, this is not real competition. Airbus is a totally phony operation. I mean, there is no market system that has produced Airbus. There is no American company that I know of that could survive 2 decades of losses, never make a profit, be shored up exclusively by the subsidies of foreign governments, and furthermore have its sales force, strongly supported by the foreign governments operating around the world, strong-arming purchasers of aircraft. This is not any market system.

Obviously, the U.S. airlines would like to buy from whomever they want. But I do not think that—I mean, maybe Mr. Crandall would like that, and maybe I am being just sort of churlish as a single member of the Senate. But I can tell you that I would not be enthusiastic about a program that would, in effect, join with the Europeans in subsidizing the purchase of this ridiculously subsidized product called Airbus.

So, that would be my view. But I am not sure that the loan guarantee idea is a great idea. Maybe it is. It is not part of my program as of now. I am willing to look at it. I do understand that if we

do it and we keep out Airbus, we have been sort of hooked on our own self-created problem with respect to the Airbus agreement. I mean, it really is a Rube Goldberg operation, in my opinion, if the next phase of our activity is going to be to provide loan guarantees so that American Airlines can buy Airbus.

Well, you all have been very good and very patient, waiting around so long this morning, and I appreciate your testimony. I would like this to go on. It is rare that a Republican gets to chair a meeting even if nobody else is here. [Laughter.]

But thank you very much for your participation and your contribution.

[Whereupon, at 12:30 p.m., the hearing was adjourned.]

APPENDIX

LETTER FROM JEFF LAWRENCE, ASSOCIATE ADMINISTRATOR FOR LEGISLATIVE
AFFAIRS, NASA

MAY 19, 1993.

The Honorable ERNEST F. HOLLINGS,
U.S. Senate,
Washington, DC 20510

DEAR MR. CHAIRMAN: The National Aeronautics and Space Administration (NASA) has reviewed the bill S. 419, the "Aeronautical Technology Consortium Act of 1993," which has been referred to your committee. I would like to share the results of our review with you so that they may be taken into consideration during the committee's upcoming deliberations.

S. 419 would require the President to establish an Aeronautical Technology Program, which would be an interagency effort to coordinate and expand Federal research and development programs relating to aeronautical technologies and related manufacturing technologies. This Program would be implemented and administered by an Aeronautical Technology Coordinating Committee (the coordinating Committee) composed of the Director of the Office of Science and Technology Policy (OSTP) (who is to be the chairperson), the Secretaries of Defense, Commerce and Transportation, the Administrator of NASA, and the Director of the National Science Foundation.

One of the purposes of this Program would be to assist the United States' commercial aircraft industry in developing an industry-led Aeronautical Technology Consortium, and to provide Federal assistance to the consortium and subordinate joint ventures for research and development and commercialization of aeronautical technologies applicable to large civil aircraft. The bill would also establish an Aeronautical Technology Advisory Committee to advise both the Coordinating Committee and the Consortium on the goals, activities and policies of each.

NASA and the Administration strongly support increased national emphasis on aeronautics research as a means to enhance the competitiveness of the U.S. aircraft industry. This support is clearly reflected in the 18 percent increase in funding for NASA aeronautics research in the President's FY 1994 budget. As part of this increased emphasis, we recognize the critical need to strengthen coordination among Federal agencies involved in aeronautical research and technology development in order to better support the U.S. aeronautical industry, and we strongly support the legislation's objectives in this regard.

However, we do have some specific concerns about selected provisions of S. 419. These concerns relate to the proposed statutory creation of additional coordinating bodies and advisory groups and to the proposed mechanism for creation of industry consortia. These provisions may not be necessary in light of the President's recent actions in this area. As you are aware, the President has expressed his strong support for a healthy and highly competitive U.S. aviation industry. In fact, he has supported creation of a "National Commission to Ensure A Strong Competitive Airline Industry" to review all major facets of the aviation industry including tax, trade, regulatory and technology issues. The members of the Commission have already been named and their findings and recommendations are due in less than 90 days.

We believe that this Commission will address many of the concerns that are raised in the proposed legislation and therefore recommend that you delay action pending the Commission's report.

As for the specifics of this legislation, we are concerned with the following:

(1) Aeronautical Technology Consortium—We believe that creation of consortia should be decided by specific industry market needs and not by statute. Although there are clear advantages to creations of consortia in general, to create one large consortium could prove restrictive, inflexible, and may in fact discourage industry participation. Instead, we recommend that consortia be formed on a case by case

basis in response to specific needs identified by U.S. companies. For example, a team of U.S. companies and universities are currently working together on a NASA materials project for high-speed research.

Another example of the need for these dynamic and focused relationships, is the recently formed aeronautics R&D facility task group which is formulating a coordinated national plan for world class aeronautics R&D facilities that meets the current and projected needs for commercial and government-sponsored research and development. This task group is looking at a broad range of needed aeronautics research facilities (e.g., wind tunnels, test stands, etc.) to support technology development (e.g. aerodynamics, aeroacoustics, propulsion, etc.) across the entire spectrum of speed regimes (e.g., transonic, subsonic, supersonic, and hypersonic). Task Group membership includes both federal and industry (e.g., General Electric, Boeing, McDonnell Douglas, United Technologies/Pratt & Whitney, etc.) representatives.

Second, the bill cites the Sematech consortium as the model for the Aeronautical Technology Consortium. We believe that this comparison misses the distinctive features of the aircraft industry. Aircraft often require over a decade of research and technology development before a product is brought to market, unlike the semiconductor products which can be done in a few years or even months. Moreover, with the longer development horizon, it is significantly more difficult for aircraft companies to match government funding early in a program as required by the bill.

Finally, the bill's restrictive language regarding non-U.S. companies may unnecessarily inhibit U.S. companies from gaining access to aircraft markets that are controlled by governmental policies.

Therefore, we recommend the requirement for an Aeronautical Technology Consortium be adjusted to allow for industry to decide when to create it, who can participate, and which government programs it will apply to.

(2) Aeronautical Technology Coordinating Committee—Pending the findings from the Commission, OSTP plans to create an interagency mechanism within its existing mandate to address many of the key issues raised in the proposed legislation. We recommend you allow the OSTP Director the opportunity to create an appropriate coordinating mechanism, as is needed, rather than statutorily mandate its creation.

(3) Aeronautical Technology Advisory Committee—We agree that industry participation and input for government technology programs is needed to maintain the proper focus; however, we believe it would be premature to decide on creation of a specific new advisory group before the Commission has had a chance to present its finding. Moreover, we are generally seeking to avoid creating new advisory committees. The President has recently directed that the number of federal advisory committees not required by statute be reduced by one-third.

NASA and other interested agencies are continuing to review the bill and may have additional comments at a later time. We look forward to working with your Committee.

The Office of Management and Budget has advised that, from the standpoint of the Administration's program, there is no objection to the submission of this report to the Congress.

Sincerely,

JEFF LAWRENCE,
Associate Administrator for Legislative Affairs, NASA.

LETTER FROM STEPHEN H. KAPLAN AND MORTIMER L. DOWNEY

MAY 19, 1993.

The Honorable LARRY PRESSLER,
U.S. Senate,
Washington, DC 20510

DEAR SENATOR PRESSLER: We appreciate the opportunity we had Monday to discuss with you the aviation accident April 19 that took eight lives, including Governor Mickelson's, and the steps we can take to prevent another such tragic accident. Small aircraft safety is and should be a priority at the Federal Aviation Administration (FAA).

You expressed particular concern that the interaction between the FAA and the National Transportation Safety Board (NTSB) may have involved bureaucratic friction that interfered with issuance of the appropriate airworthiness directive as soon as there was a basis for one. We have looked into the chronology in this case and found that the relationship worked as it was intended under statute, and that both agencies appear to have done their best with the information they had available.

This by no means suggests that further steps would not improve safety for the public.

The NTSB was created by Congress to investigate transportation accidents, make determinations of probable cause, and make safety recommendations to the regulating agency, in this case the FAA. Congress separated the NTSB from the Department in 1975 to help assure the independence of its accident findings and safety recommendations. The responsibility for issuing safety regulations and directives is lodged separately with the FAA, freeing the NTSB from any of the balancing of issues implicit in the regulatory process, but the FAA has a statutory duty to consider and respond to all NTSB recommendations on air safety. The record shows a very high level of positive response by the FAA to NTSB recommendations, with more than 90 percent of its urgent recommendations, and more than 80 percent of all its recommendations, adopted by the FAA. DOT's Inspector General has examined the FAA's record of response and found that, except in the case of the lowest priority recommendations, the FAA has, on average, responded to the NTSB more rapidly than its guidelines specify for response.

Without making any ultimate judgment about the causes, we would like to review the facts leading up to the April 19 crash. The first evidence FAA had of a problem with the propeller in question was the loss of a propeller in flight from an MU-2B-60 aircraft September 27, 1991, followed by a safe landing. The specific model propeller had been in service for 20 years with millions of flight hours accumulated. The NTSB's investigation led to an August 1992 recommendation to the FAA that it join with the propeller manufacturer in developing a non-destructive inspection technique to examine the inner propeller surfaces for the fatigue cracking that appeared to be the cause of the failure. The NTSB recognized that disassembly to examine the inner areas could lead to maintenance-induced damage that might be more serious than the cracking it sought to locate. NTSB also recommended requiring an inspection schedule of blades in service over 3,000 hours.

The FAA responded quickly to the August recommendation by advising the NTSB on October 26 that a review of relevant information was underway. Although not mentioned in the October 26 letter, the FAA had begun discussing a non-destructive inspection technique, as recommended by the NTSB, with the manufacturer.

On January 4, 1993, the FAA provided its full response to the NTSB. The agency had examined all the relevant historical data on the propeller type and similar propellers in use over three decades and found no comparable case of cracking. The manufacturer's testing showed that stress levels of the propeller area in question were acceptable, and that no metallurgical discrepancies were found in the hub material. FAA reviewed the service history of the propeller and contacted propeller overhaul shops to gather any additional anecdotal information. No cracking at all had been reported in thousands of normal maintenance sessions. Because this led the FAA to conclude the 1991 case was an isolated incident, the FAA decided not to issue a mandatory inspection directive at the time. Significantly, no method had been (or yet has been) developed to permit inspection that avoids disassembly and the possibility of maintenance-induced damage. The FAA indicated it was continuing to monitor the service performance of this propeller. On March 4, the NTSB responded and reiterated its view that a non-destructive inspection methodology should be developed and applied. The NTSB also noted concern that the FAA had not seen a need to review the design and fabrication of similar propeller types.

The FAA and the manufacturer have continued the search for an inspection method that avoids disassembly and the risk of induced damage. Many methods, including x-ray, eddy current, and ultrasonic techniques, have been evaluated and found unsatisfactory. The manufacturer has concluded that current technology is not at a stage where inspection can be accomplished without disassembly.

When the April 19 crash occurred, involving an identical model aircraft, the FAA responded within 10 days by establishing that a pattern of fatigue cracking existed, and that inspection involving disassembly must be undertaken. In view of the potential for damage in the inspection, the FAA has required that the inspection only be conducted at the manufacturer's factory laboratory. This step is intended to maximize speed and consistency of data collection as well as minimize the possibility of maintenance-induced damage. The FAA continues to work closely with the NTSB on this issue, but the engineering and other data do not suggest an explanation for the cracking and fracture.

In our review of these facts, it appears that the two agencies performed appropriately. Nonetheless, we look forward to working with Congress specifically on how the area of small aircraft safety might obtain greater emphasis. The accident statistics demonstrate that the safety record has steadily improved. The FAA believes that the high profile it gives small aircraft safety, such as its small airplane air-

worthiness reviews and its positive safety outreach program, contributes to the improvement. However, we should continue to pursue further improvement.

We share Secretary Peña's firm belief and the fundamental premise that the Department of Transportation is committed first and foremost to safety in the day-to-day operations of all modes of transportation. He strongly supports the NTSB in its role in the area and intends to monitor the response of all DOT agencies to the NTSB's recommendations.

In closing, we hope to have the opportunity to work with you and the Aviation Subcommittee on the continuing issue of small aircraft safety.

Sincerely,

STEPHEN H. KAPLAN.
MORTIMER L. DOWNEY.

QUESTION ASKED BY SENATOR PRESSLER AND ANSWER THERETO BY FAA/NTSB

Question. Are you familiar with the current relationship between the DOT, the FAA, and the NTSB? In your position at the Department of Transportation, what role do you feel the DOT should play in its relationship with the FAA and the NTSB? Are you satisfied with the current relationship between DOT and the FAA? Do you feel that the FAA, like the NTSB, should be an agency independent of the DOT? What is the Administration's feeling on these issues? What are some ways that the DOT can best utilize the FAA or other resources to promote and enforce small aircraft safety?

Answer. I am generally familiar with the relationship between the DOT, the FAA, and the NTSB, and the different statutory roles that the NTSB and FAA have in promoting safety. The NTSB is responsible for accident investigation and making safety recommendations to the FAA. The FAA bears responsibility for the promulgation and enforcement of safety regulations, and is charged with responding directly to NTSB safety recommendations. DOT maintains general oversight over this relationship, not second-guessing FAA on its technical safety judgments, but assuming that FAA (and other modes of transportation) are working cooperatively with the NTSB and meeting prescribed timetables for responding to NTSB recommendations.

Based on my knowledge of the Department to date, I believe this relationship is probably the appropriate one for DOT, given the FAA's safety mandate and the technical expertise it possesses. I would note that a recent DOT Inspector General report credited FAA with overall timely response to NTSB recommendations. Also, I am advised that, historically, FAA has adopted more than 80 percent of NTSB recommendations. More than 90 percent of the NTSB Class I (urgent) recommendations have been adopted by the FAA.

In terms of FAA's status within the Department, I believe that maintaining the current relationship is appropriate. Secretary Pena has established a positive working relationship with the FAA, and we expect to build on that spirit of cooperation. All of us agree that aviation safety must occupy the highest priority within the FAA, and that efforts must continue to improve upon the excellent safety record attained in all segments of air transportation. In fact, I am told that the general aviation safety record has seen continuous long-term improvement, resulting in the lowest accident rate in history in 1992. FAA enhanced safety regulations and a positive safety outreach program undoubtedly have contributed to this improvement.

Most important, I agree with Secretary Peña's conviction that we cannot simply be content with the current record, no matter how good, and that we must work with the FAA to assure that it possesses the necessary resources, and continued commitment from the Administrator to the air traffic controller, to perform its safety functions to the best of its ability.

QUESTION ASKED BY SENATOR INOUE AND ANSWER THERETO BY MR. DOWNEY

Question. You are no doubt well aware of the serious financial problems in which our nation's aviation industry finds itself. In Hawaii, we have a microcosm of those problems among our State's intra-island carriers. These financial problems, however, are even more dramatic and more serious to our State in terms of social and economic impact because air service is the only means by which passengers and, in many cases, cargo, move throughout the seven inhabited islands which comprise Hawaii. Recently, the Hawaii Legislature enacted legislation which provides a loan guarantee mechanism for our intrastate carriers and a regulatory regime for intrastate carrier operations. The purpose for the legislation was to ensure that air service is maintained among our islands and to provide a controlled structure in which

the economic health of our intrastate carriers could be restored, while safeguarding the consumer interest of Hawaii residents. The bill will only affect truly intrastate flights. The State legislation requires a change in federal law before its provisions become effective. Recognizing the unique role air service has on the transportation of people and goods in Hawaii, will you and the Department of Transportation support such a change in federal law with respect to this legislation and join with me and my colleagues in attempting to make necessary federal statutory changes to allow this legislation to become effective in the State of Hawaii?

Answer. I am advised that the Department's policy and legal offices are aware of the new provisions passed by the Hawaii Legislature, which provide a loan guarantee mechanism for inter-island airlines as well as a regulatory regime for inter-island airline operations. However, the Department has not yet developed its position on the legislation.

I recognize the significance of dependable air transportation to Hawaii and its unique place in the nation's air transportation system. Like Alaska, the state has intrastate air transport needs that are rarely faced by any other state. We would be pleased to work with you and with the Committee on addressing these needs appropriately.

In addressing the issues, it is important to consider that the Federal Aviation Act of 1958 and its predecessor statutes have long stood for the proposition that aviation is inherently an issue of interstate commerce. I am told that, as the law stands, Congress explicitly preempted state regulation of the "rates, routes, or services" of certificated air carriers. Any proposed change in this fundamental aspect of aviation regulation deserves the highest level of scrutiny. I am prepared to work with the Congress if it is your desire to review this matter.

QUESTION ASKED BY SENATOR INOUE AND ANSWER THERETO BY MR. KAPLAN

Question. On February 23, 1993, I sent a letter to Secretary Peña regarding a Department of Transportation Inspector General's report which questioned the treatment of Hawaii state airport revenues which are transferred from the Hawaii State Airport Revenue Fund into the State of Hawaii General Fund. The Inspector General asserted in that report that the State should repay \$36.7 million of State funds to the State Airport Revenue Fund. My letter further details the various aspects of this issue and states my belief that the State of Hawaii dearly meets the prior exdusion or "grandfather" provision of the applicable statute which the Inspector General asserts the State has violated. As Ranking Member of the Senate Aviation Subcommittee at the time that the Airport and Airway Improvement Act was enacted, I can assure you that it was my belief that the statutory language we wrote was designed to protect the airport financing structure which the State of Hawaii has had in place since 1955. May I ask you to advise me as soon as possible as to when this issue will be resolved. Follow-up efforts by the State of Hawaii Department of Transportation and my own staff have failed to obtain any additional information. Moreover, the Federal Aviation Administration has prevented the State from receiving any airport discretionary grants or even approve proposed consultants for an environmental impact study at Maui's Kahului Airport until this issue is resolved. At a time when the President's economic program is promoting job creation and long-term investment, we in Hawaii are unable to take any steps in that direction with respect to our vital air service system.

Answer. I am sensitive to Hawaii's concern about this issue. I understand that the DOT staff has drafted a determination on this matter, which is in the deariance process A. within the Department. The Department anticipates a response to the State by the end of this month, and DOT will certainly notify you of the determination.

QUESTIONS ASKED BY SENATOR HOLLINGS AND ANSWERS THERETO BY DR. PERRY

AMERICAN TECHNOLOGY

Question 1. Do you believe that American manufacturers are behind Airbus in terms of technology?

Answer. No. We believe the American aircraft industry is the world's leader in both technology and competitiveness, although there is no doubt that competition is keen. An argument is sometimes made that Airbus aircraft are more technologically advanced than current U.S. commercial aircraft—digital electronic flight control is an example often cited. However, the technology incorporated into an aircraft depends on the date of introduction of the aircraft and the design choices made

by the manufacturers, and is not necessarily indicative of the technological state of the art. For example, in the case of electronic flight control, this was first demonstrated in the United States in 1873, and has been incorporated into many military aircraft. So, the fact that electronic flight control has not yet been incorporated into an in-service U.S. commercial aircraft does not indicate that the United States is technologically behind, but rather that the manufacturers have opted not to incorporate it as yet—the Boeing 777 will be the first U.S. commercial aircraft with electronic flight control.

Question 2. One aspect of S. 419 would mandate an aircraft technology coordinating process, with the Office of Science and Technology Policy as the lead agency, and the Department of Transportation, the Department of Defense, the National Aeronautics and Space Administration, and the Department of Commerce having input. Currently, are there any problems in coordination among the agencies? Are there any advisory committees that provide industry input into agency research programs?

Answer. We do not believe there are major problems in coordination among the agencies, but we do believe that coordination can and will be improved. Considerable effort is devoted at all levels to ensure that our aeronautical technology programs are complementary with those of other agencies, and that they address needs in our respective mission areas. An area that perhaps could be improved is obtaining a greater degree of a priori integration of our programs, and we are, for example, currently working with NASA to revise the operation of the Aeronautics and Astronautics Coordination Board toward this end.

DOD has no formal advisory committees—analogueous to NASA's Aeronautics Advisory Committee—that are dedicated to providing input into our aeronautics technology programs. We do have several committees—for example, the Defense Science Board, the Army Science Board, and the Air Force Scientific Advisory Board—that provide input for our aeronautical research programs from time to time. Of equal importance, we have many less formal relationships with the aircraft industry that provide continuing opportunities for a full exchange of views on our respective aeronautical technology programs.

QUESTIONS ASKED BY SENATOR HOLLINGS AND ANSWERS THERETO BY MR. HAUSER

Question 1. In your testimony you suggested that product liability reform "is an item that is on the Administration's agenda". You also stated that "The Administration is studying carefully what kind of improvements could be undertaken". There has been much debate over this issue before the Commerce committee and within the Senate. Is the Department of Commerce the agency responsible for determining the Administration's position on this issue? Who has the responsibility within the Department of Commerce to make recommendations concerning product liability?

Answer. The Department of Commerce follows very closely efforts to change the product liability system. However, the issues involved in changing our product liability laws are of interest not only to this Department, but also many others, including the Department of Justice and Labor. In the Department, the Secretary can rely on a broad range of officials for advice, including the General Counsel, the Assistant to the Secretary for Policy, the Under secretary for international Trade and the Under Secretary for Economic and Statistical Affairs.

Question 2. In a letter to Congressman Tom Lewis (R-Fl), the Secretary stated: "I intend to ask the National Economic Council to consider your request [regarding the effect of product liability on the aeronautics industry] that the Government undertake an independent assessment of the magnitude of product liability law on U.S. aeronautics competitiveness." Does the Department of Commerce have a position regarding product liability legislation? Does the Secretary intend to ask the NEC to consider whether this issue of product liability legislation should be considered? Would you please clarify for the record the Department's position on this issue?

Answer. The Department has not taken a position regarding product liability legislation. To clarify the record, in light of the broad range of agencies that have an interest in this topic, Secretary Brown has expressed an intent to ask the National Economic Council to consider several Congressmen's request that the Government undertake an independent assessment of the magnitude of the impact of product liability laws on U.S. aeronautics competitiveness.

Question 3. Do you believe that American manufacturers are behind Airbus in terms of technology?

Answer. In terms of technology, the U.S. aircraft industry does not lag behind Airbus or any foreign competitor. However, the United States does not continue to

hold the substantial technology lead it enjoyed in the 1950's through the 1970's. The technology gap has narrowed and, in some instances, the Airbus countries are ahead of the United States in the commercialization of technology. For example, even though NASA developed the fly-by-wire technology, Airbus was the first manufacturer to use the technology on its aircraft. As the aircraft industry becomes more international, the competition in terms of technology is becoming more intense.

To maintain or increase the U.S. competitive edge, the United States has to forge stronger cooperation channels between government and industry. We also have to become more aware of the technological developments available to our competitors.

The Administration is placing greater emphasis on the commercial aspects of U.S. Government research and technology. We continue to lead in overall aerospace technology, but the race to maintain leadership has many international competitors and the technological skills of the major competitors, including Airbus, could surpass the United States in the next century if we do not build a strong government-industry technology program.

Question 4. One aspect of S. 419 would be to mandate an aircraft technology research and development coordinating process, with the Office of Science and Technology as the lead agency, and the Department of Transportation, the Department of Defense, the National Aeronautics and Space Administration (NASA), and the Department of Commerce having input. Currently, are there any problems in coordinating among the agencies? Are there advisory committees that currently provide industry input into agency research programs?

Answer. The coordination process between agencies can be, and is being improved. As I testified, many of the activities proposed in S. 419 are already being conducted at the agency level. The Office of Science and Technology Policy is considering ways to improve interagency coordination. In many instances, individual agencies have been working with U.S. industry and receiving advice on an agency-by-agency basis. Commerce, for instance, continuously seeks industry advice in many sectors, including aerospace, through the industry sector advisory committee process. Other agencies have similar mechanisms for ensuring industry participation in the decision process.

Greater sharing of the industry advice, as well as understanding the policy problems facing each agency, are goals of the Administration as we develop a coordinated approach to the problems of the aerospace industry. Efforts toward better communication and coordination will require increased commitment and cooperation.

Question 5. Because of its relationship to the European governments, Airbus is able to initiate projects that U.S. manufacturers cannot, particularly because of the financing it can obtain. While all of the U.S. companies have had to reduce production, Airbus, despite a series of cancellations, has not reduced production and will be marketing "whitetails"—aircraft produced without an immediate buyer. Have you had any indications that Airbus will be selling whitetails? In this regard, is the Department of Commerce monitoring the financing schemes employed by Airbus? Are there concerns about walk away leases or other terms? Are such schemes permitted under the Large Aircraft Sector Understanding (LASU), which specifies the terms and conditions of official export financing for large aircraft?

Answer. The Department of Commerce has been monitoring the production and marketing activities of Airbus and will continue to look for instances of activities that could violate provisions contained in U.S. bilateral or international trade agreements. Due to the downturn in orders, Airbus has stated that it is reducing production of certain models and revising its production schedules for the future. As Airbus has a substantial backlog and is in the process of adding production lines for its A330/340 program, it is realistic that it can revise production plans and avoid producing whitetails without incurring reductions in workforce similar to those faced by U.S. industry. Commerce will closely watch the situation involving possible whitetails.

Regarding the financing options Airbus is offering to its customers, the Administration continues to monitor these schemes. To date, Airbus has abided by the terms and conditions of the LASU which governs only the actions of European export credit agencies similar to our Eximbank.

When the financing is offered by the Airbus consortium companies, either through leases or direct loans and guarantees, the LASU has no jurisdiction. Commerce and U.S. industry are concerned that this type of financing is trade-distortive, as Airbus is viewed by the international financial community as a virtual parastatal company in terms of credit and access to capital. The Administration, in current discussions with the European Community, has raised the issue of walk-away leases and the implicit involvement of the Airbus governments in underwriting the credit of the Airbus consortium. At present, the Administration is reviewing possible courses of

action that would result in the Airbus consortium having to obtain international financing on terms and conditions similar to those facing U.S. industry.

QUESTIONS ASKED BY SENATOR HOLLINGS AND ANSWERS THERETO BY MR. GOLDIN

Question 1. Do you believe that American manufacturers are behind Airbus in terms of technology?

Answer. U.S. manufacturers are not behind Airbus in the availability of advanced technology for applications to new commercial transport designs.

However, Airbus has been more aggressive than U.S. manufacturers in applying new technologies to current transport aircraft designs. Airbus was first to apply winglets, fly-by-wire controls and major composite structures. There are multiple reasons for their lead in these applications. For example, Airbus can accept larger risk to the costs of their aircraft because of production subsidies, while U.S. industry must balance the application of new technologies and the performance benefits against the real acquisition cost of the airplane to the operators. This often results in earlier applications by Airbus. In other cases, the difference in applications is strictly a design decision. Some cockpit automation technologies, applied initially by Airbus, have actually increased pilot workload and not benefited the operators. U.S. manufacturers have more selectively applied these technologies to greater benefit.

The principal shortfall in U.S. technology development has been insufficient validation and risk reduction to allow U.S. manufacturers to take full and early advantage of technology availability. The proposed NASA Aeronautics enhancements for FY 1994 focus on cooperation with industry through the technology validation phase.

In terms of supersonic transport technology, Two of the Airbus manufacturers, British Aerospace and Aerospatiale, have the considerable advantage gained from building the Concorde and supporting the operations by British Airways and Air France for over 17 years. This experience, in addition to the research they have been conducting toward a Concorde successor, gives the European manufacturers a head start at the current time over American manufacturers. However, they still lack the technologies that will enable gem to build an economically and environmentally viable design. NASA's High Speed Research Program is designed to develop and validate advanced technology that will help U.S. industry decide whether to develop and build a supersonic transport that can succeed in the marketplace.

GOVERNMENT COORDINATION

Question 2. One aspect of S. 419 would mandate an aircraft technology research and development coordinating process, with the Office of Science and Technology Policy as the lead agency, and the Department of Transportation, the Department of Defense, the National Aeronautics and Space Administration (NASA) and the Department of Commerce having input. Currently, are there problems in coordinating among the agencies? Are there advisory committees that currently provide industry input into agency research programs?

Answer. While there has been no legislative requirement for NASA to coordinate with other federal agencies specifically in aeronautics, significant cooperation has occurred in many areas of research and technology development because it is necessary and advantageous to national interests and the interests of each agency. For example, the FAA-NASA Coordinating Committee was formed to focus on airplane/airport integration issues and the Aeronautics and Astronautics Coordinating Board between NASA and DOD has provided greater coordination and return on investments in many of our aeronautics R&T activities. These committees provide benefits through closer working relationships and can preclude duplicative activities.

The NASA Aeronautics Advisory Committee (AAC) has been in existence for many years. The principle goal of the AAC is to provide a forum for a collective input from industry into the Aeronautics program. We believe this creates a balanced, integrated program with a national perspective.

NASA PROGRAMS

Question 3. You have discussed the importance of NASA's aeronautics research programs to the aircraft manufacturing industry. What steps has NASA taken to ensure that the technology development under these programs is effectively transferred to industry? How does NASA ensure that American manufacturers have access to these technologies before foreign companies?

Answer. NASA generally performs its research in cooperation with the aeronautics industry, thereby providing some direct mechanisms for technology transfer. However, we are stepping up our efforts to increase and improve industry involve-

ment in both planning and implementing our programs. Additionally, much of the Aeronautics investment, beginning in FY 1994, is aimed at developing technologies to a more advanced stage, reducing the risks sufficiently for industry commercialization. Industry's partnership in the NASA program should allow manufacturers to easily continue technology development through commercialization, as desired. Furthermore, the natural advantage U.S. industry is afforded through direct partnership in the NASA technology development program will be supported by NASA contracts and cooperative agreements which include provisions to protect commercially valuable and/or sensitive technology from premature foreign dissemination.

QUESTIONS ASKED BY SENATOR BURNS AND ANSWERS THERETO BY MR. GOLDIN

Question 1. Mr. Goldin, I'd like to ask you for a progress report on the development of the High Speed Civil Transport Aircraft and the National Aero-Space Plane. If you would, provide the Committee with your timeline for the commercialization of these aircraft; that is, when can additional private-sector companies beyond the five major industry partners currently involved expect to compete in the development and construction of the planes?

Answer. NASA's High-Speed Research program is focusing on developing the critical technologies needed to ensure that U.S. industry will be first to develop a commercially viable High Speed (mach 2.5) Civil Transport (HSCT) aircraft that could carry 300 passengers 5000 miles and that would be environmentally acceptable. Launching an airplane development program requires a major investment of private capital and a risk-benefit assessment, a decision which only industry can make. The High-Speed Research program, a joint NASA and industry effort, is providing the necessary technical information to support these decisions. Phase I of the HSR program, begun in 1990, is focusing on developing the technology to ensure environmental safety—a future aircraft must not harm the ozone layer, must meet the same stringent noise requirements as subsonic aircraft, and must have acceptable sonic boom levels. General Electric, Pratt & Whitney, and a number of smaller companies and university partners are working as a team on the engine work for Phase 1. Phase H, planned to begin in FY 1994, will focus on the technologies that will make the aircraft affordable to build and operate, and therefore profitable. It is likely that some sort of teaming arrangement between large and small aircraft manufacturers and other partners will be set up to conduct airframe research activities. The timeline for commercial development of the HSCT will be determined by industry, but a product development decision is likely in 2001, when the technologies required are well understood, with certification of the aircraft and introduction into commercial service to follow around 2006.

The National Aero-Space Plane program is a joint program with the Air Force, and is aimed not at supersonic technology for a foreseeable commercial product like HSCT but rather at hypersonic technology to enable future operational civil and military vehicles. There are five major industry partners involved in the NASP program, along with numerous smaller companies. The timeframe where commercial vehicles may be produced is not easy to predict, because of the immature state of technology, but certainly NASP-derived commercial vehicles will not be produced by the private sector within the next 25 years. A summary of NASP technical achievements to date, as well as information on the proposed risk reduction phase and nearer-term technology benefits of NASP is enclosed for further information.

Question 2. The research suggests that existing U.S. wind tunnels are on average about 40 years old and provide inadequate representations of flight conditions. As a result, we understand that American aircraft manufacturers have to test their planes in foreign wind tunnels. Describe in further detail, beyond your prepared remarks, the effort and the investment needed to upgrade our facilities here in the U.S., and how that would be affected by Senate Bill 419.

Answer. In FY 1989, NASA began an approximately \$300 million Major Wind Tunnel Revitalization Program to refurbish and modernize NASA's most critical facilities. Fiscal year 1994 is the final year for the program. The FY 1994 projects, totaling \$31 million, are: Modernize Ames Unitary Wind Tunnel, Phase 2, \$25 million; Upgrade Ames Outdoor Aerodynamic Res. Fac., \$3.9 million; and Rehab Control Systems, Ames NFAC, \$2.1 million.

While the Wind Tunnel Revitalization Program will improve the quality of NASA's wind tunnels, it does not adequately provide the increased capability to simulate flight conditions, nor does it increase productivity necessary for future aircraft development by industry. Therefore, the NASA Administrator has initiated a study to develop a coordinated National Plan for World Class Aeronautical Facilities that meet the current and projected needs for commercial and government-sponsored re-

search and development with the primary objective of satisfying U.S. aerospace industry needs. The plan is being developed by a joint NASA/DOD/industry team, and is being coordinated with the Departments of Energy, Commerce, and Transportation, and the National Science Foundation. The study is addressing shortfalls in existing capability, requirements for new facilities, and consolidation and phase-out of existing facilities. New facility requirements will be prioritized, and detailed schedules and funding requirements specified. Shared funding by government and the private sector is being considered.

Preliminary results indicate that two new development-oriented wind tunnels may be needed—a subsonic tunnel with a 16x20 foot test section, and a transonic tunnel with an 11x15.5 foot test section. A dedicated team is currently evaluating the facility design specifications and siting options, and refining cost and schedule estimates to enable a decision whether and how to proceed with development. In FY 1994, \$74 million is requested to complete the study activity and begin preliminary design of the tunnels, should they be deemed necessary.

Significant improvements to the U.S. testing infrastructure for aircraft research and development are required in the next five years, particularly in support of more stringent aerodynamics and acoustic performance goals. These improvements involve significant upgrades to existing facilities, providing greater productivity and increased capability. The first upgrade, acoustic treatment of the 40x80 foot wind tunnel at NASA-Ames, has been initiated in FY 1993. Additional facility improvements are requested in the FY 1994 budget submission to address the following needs:

\$60 million will provide substantial productivity improvements for the National Transonic Facility at NASA-Langley by modifying systems such as the nitrogen supply/exhaust, drive control and data acquisition.

\$20 million will be used to improve the capability and productivity of the Unitary Plan 11-foot wind tunnel at NASA-Ames by increasing the Reynolds Number test parameter. This will be accomplished by utilizing the existing higher pressure shell capability and replacing compressor blades and motor windings.

\$27 million requested for the Composite Technology Center at NASA-Lewis will enable research in advanced composite materials, which is critical in the development of lightweight, fuel-efficient next-generation aircraft like the High Speed Civil Transport.

Senate Bill 419 would have little to no effect on these planned facility investments.

Question 3. In Montana, Essential Air Service holds our communities together.

You note in your testimony NASA's desire to place a new emphasis on fixed wing short haul aircraft technology, with the goal of revitalizing that segment of the airline industry. Would you explain how your program can help essential air service in states like mine? Have you examined that yet?

Answer. The overall objective of the proposed Advanced Subsonic Technology Initiative is to provide a state of technology readiness for U.S. leadership in developing a new generation of civil subsonic aircraft and engines and a safe and uncongested integrated air transportation system that includes expanded utilization of shorthaul aircraft States such as Montana, that depend on essential shorthaul aircraft service will be the primary beneficiaries of this expanded utilization. As shown on the enclosed charts, the current major hub and spoke infrastructure concentrates the bulk of the passenger service into the major population centers. Higher utilization of the 5200 U.S. public-use airports by shorthaul and general aviation aircraft would dramatically increase service and availability to less densely populated parts of our nation, such as Montana. Approximately 35 percent of the proposed program is focused on aviation system and shorthaul aircraft technology that will directly benefit states with aviation requirements similar to those of Montana.

HUB-SPOKE INFRASTRUCTURE



OVERVIEW

Top 71 Large and Medium Hubs
(89% of Air Carrier Passengers)



GENERAL AVIATION INFRASTRUCTURE

OVERVIEW

5200 Public-Use Airports



NATIONAL AERO-SPACE PLANE (NASP) PROGRESS REPORT—TECHNICAL ACHIEVEMENTS

The NASP program has continued to achieve significant technological progress during the past year. The most highly integrated task has been the design of the NASP flight-research vehicle—the piloted, full-scale X-30. The X-30 serves as a means of focusing the program, in part by using it to assess the value of specific technological advances. The currently proposed period of risk reduction should lead to a lighter-weight, less costly X-30.

NASP continues to push the state-of-the-art in a number of technical areas. The following overview describes some of the many advances achieved during the past year.

Progress in aeropropulsion was highlighted by a series of long-duration wind tunnel tests up to Mach 14 of a large-scale model of a NA5P scramjet combustor. The test periods of more than ten seconds are substantially longer than the millisecond tests conducted with shock-tubes and other pulsed-type scramjet-test facilities. They have provided a wealth of valuable new data for simulated flight speeds above Mach 8. The new tests were accomplished at the NASA Ames 100 Megawatt "Direct Connect Arc Facility" with a NASP team led by the Applied Physics Laboratory of Johns Hopkins University.

Other propulsion activities included complementary tests from Mach 3 to Mach 8 test conditions at NASA Langley Research Center. These provided data on enhancements to the scramjet design for the X-30. In addition, component tests at the high scramjet operation speeds have continued to provide important data. Rocketdyne tests at the CalTech T5 tunnel and related work at the "HYPULSE" facility in New York have revealed new insights into the design and operation of scramjet fuel injectors at Mach 16 flight conditions. Tests up to Mach 18 in the Naval Surface Warfare Center Tunnel Number 9 in Maryland have contributed valuable data on NASP inlet configurations. These and other aeropropulsion advances were matched by improvements in the associated laser-based instrumentation techniques and by updated methodologies for computer analyses.

Previous work had advanced slush-hydrogen fuel technologies from laboratory exercises to large-scale production and ground handling. More recent activities addressed onboard fuel-related operations. In contrast to rocket boosters, NASP fuel tanks are horizontally mounted, have much larger surface areas of fuel and must accommodate recirculation of fuel heated in the actively cooled structures. The NASP fuel system must cope with fuel flow ranging from a super-cold (cryogenic) slush up through superheated hydrogen gas. The research and development conducted at NASA Lewis Research Center in cooperation with industry partners (Martin Marietta and others) has been essential to define the best slush-hydrogen hardware configurations and modes of operation for NASP.

NASP aerodynamics researchers have also made advances. NASA Langley Research Center and McDonnell Douglas completed a X-30 wind tunnel test series from takeoff to Mach 17+ to provide a solid data base on aerodynamics, stability and controllability. Boundary-layer transition from smooth (laminar) to turbulent strongly affects local structural heating (and, consequently, vehicle weight) and engine inlet performance. Research in hypersonic boundary layers has emphasized improvements to predictive tools, especially to account for the effects of shock waves. Finally, propulsion/airframe integration saw major advances in the development of test techniques.

NASP materials science has continued to build an extensive data base on advanced materials and coatings, while new structural tests have validated both fabrication and analysis techniques. Fiber-stiffened, titanium-aluminum metal-matrix composites (TMC) are now understood in much greater depth. This knowledge has been used in combination with the Textron TMC pilot plant in Massachusetts to demonstrate manufacturing techniques for consistently high-quality material. New coatings technologies are providing superior oxidation resistance for carbon-carbon heat shields and for highly conductive metallic alloys used in actively cooled engine components.

The NASP team has conducted successful thermal and mechanical tests of NASP panel assemblies which have joints, numerous fasteners and complex curves. These structures represented specific segments of the X-30 fuselage. Other realistic tests of heat exchangers, engine hot-gas seals, actively cooled leading-edge-type structures, and internal substructure were also successful. Examples of typical but sophisticated tests are those for a 2-by-5-foot, titanium metal-matrix composite (TMC) panel assembly at The Air Force's Wright Laboratory in Dayton, Ohio, and a slightly smaller TMC panel assembly at NASA Dryden Flight Research Facility in California. In many cases, the greatest challenges have been to provide the high-temperature instrumentation as well as the simulated extremes of combined thermal, mechanical and acoustic loads.

Aero-structural loads are important for NASP, too. Aeroelastics, the coupling of aerodynamic loads and structural characteristics, was substantially advanced by both analytics and special tests in the NASA Langley Transonic Dynamics Tunnel (the national facility for aeroelastic testing). The culmination of the work to date has been the definition of NASP structural and controls requirements to match the expected flight-path conditions. Other technology-development activities included using new and existing facilities to subject large panels to the combination of hot

gas flow and extreme acoustic loads (over 180 dB) simulating NASP nozzleflow conditions. (These tests were conducted at Rocketdyne, Wright Labs and NASA Langley sites.)

There have been advances in many other areas, such as instrumentation, simulation and computational fluid dynamics (CFD). The challenging structural environment for parts of the X-30 (-423 to over 4000 degrees Fahrenheit) calls for truly advanced instrumentation: for example, metallic gauges that measure bending loads can undergo a transformation of the crystalline structure of the gauge metal as it heats to these high temperatures. Improvements in strain-gauge designs are now providing the rugged, dependable instrumentation essential for piloted flight-research vehicles. Moreover, recent advances in fiber-optics enable the measurement of distributed loads with a single fiber strand as well as providing secure data-signal paths through extremely hot structures. NASP vehicle-simulation work achieved a program milestone by demonstrating controllability for the existing integrated X-30 design. In addition, CFD has become a routinely applied but very powerful tool for either analyzing data or predicting the behavior of purely conceptual flow fields. NASA has transferred CFD tools to industry experts to enhance both hypersonic calculating efficiency and fidelity of the simulation of natural phenomena.

RISK-REDUCTION

Projections of the NASP program for FY 1994 and beyond have been strongly influenced by the need to reduce technical risk and to present an affordable, well focused research on hypersonic aerospace planes that will make significant progress in key areas. We are focusing on a few areas, such as high-speed scramjet performance, in response to in-house analyses as well as reviews by key members of the scientific community. Current plans call for a six-year period of technological risk reduction leading to a decision to build and fly the X-30 in the late 1990's. The benefits of this approach should be a lighter, less expensive X-30 with significantly reduced technical risk as well as significant technical progress applicable elsewhere in aeronautics/aerospace and other industries.

The recommended risk-reduction program would encompass a balance of flight and ground-based activities to further investigate key hypersonic technologies. Ground-based tests and sophisticated analyses would ensure maturation and integration of NASP technologies to even higher levels of confidence. ICBM rocket boosters rendered surplus by the end of the "Cold War" would serve as dramatic "peace dividends" for hypersonic aerospace plane research. These rockets would be used in boosting subscale, unpiloted experiments to high-speed test points. Each type of flight test would be well anchored by tests in ground-based facilities. The results would be the demonstration and verification of key technologies, such as those for predicting hypersonic boundary-layer transition (to turbulent flow), high-Mach-number stability and controllability, and both the performance and operability of scramjets at Mach 12 to 15.

TECHNOLOGY BENEFITS

The transfer of hypersonic technologies to U.S. industry for a variety of applications will continue, becoming more prevalent during the coming years. While these benefits alone are not sufficient reason for conducting a research program, they are important and should be both encouraged and factored in program planning. In many ways, the NASP program has set the example for being proactive in this domain. Close interactions with industry range from "showcasing" hypersonic technologies at regional meetings to operating a team of Air Force reservists as technology applications specialists.

The initial technology transfer of materials, material-processing techniques and computer-science applications has been well documented. In one example, applications for a Beryllium alloy (developed for NASP) in the computer industry has been credited with saving the U.S. Beryllium industry and pushing it into high-capacity operations. In this case, an investment of \$657,000 by the NASP program has resulted in a market conservatively estimated at \$137 million over the next three years—a return on investment of 208 to one! Specially processed metallic laminations (with up to hundreds of thin sheets) have enabled very sophisticated tailoring of physical and chemical properties of structures. In contrast, a recent NASP innovation involves great promise for eye surgery, where computational methods for fluid dynamics in the eye would allow surgery to be more precise and successful. These are only a few examples; it is noteworthy that two full sessions of the recent NASP Technology Review in April of this year were devoted to technology transfer.

Industry has contributed in excess of \$700M of the \$2.413 invested in NASP. In addition to the five major NASP partners (Lockheed, McDonnell Douglas, North

American Rockwell, Pratt & Whitney, and Rocketdyne). additional major private sector company (e.g., Boeing and Martin Marietta) participation is anticipated during the risk reduction activities.

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